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Mimassi

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(54) **SYSTEM AND METHOD FOR ZERO-STEP PROXIMITY DETECTION AND PRIVATE MATCHMAKING USING MOBILE DEVICE LOW EMISSIONS BEACONS**

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(63) Continuation-in-part of application No. 17/091,925, filed on Nov. 6, 2020, now Pat. No. 11,334,866, which is a continuation-in-part of application No. 17/005,038, filed on Aug. 27, 2020, now Pat. No. 11,232,426, which is a continuation-in-part of application No. 16/796,342, filed on Feb. 20, 2020, now Pat. No. 10,803,442.

(60) Provisional application No. 63/070,895, filed on Aug. 27, 2020, provisional application No. 62/964,413, filed on Jan. 22, 2020, provisional application No. 62/938,817, filed on Nov. 21, 2019.

(51) **Int. Cl.**

G06Q 30/02 (2012.01)

H04B 17/318 (2015.01)

H04W 4/029 (2018.01)

H04W 4/80 (2018.01)

(52) **U.S. Cl.**

CPC **G06Q 30/0281** (2013.01); **G06Q 30/0201** (2013.01); **H04B 17/318** (2015.01); **H04W 4/029** (2018.02); **H04W 4/80** (2018.02)

(58) **Field of Classification Search**

CPC G06Q 30/0281; G06Q 30/0201; H04B 17/318; H04W 4/029; H04W 4/80
See application file for complete search history.

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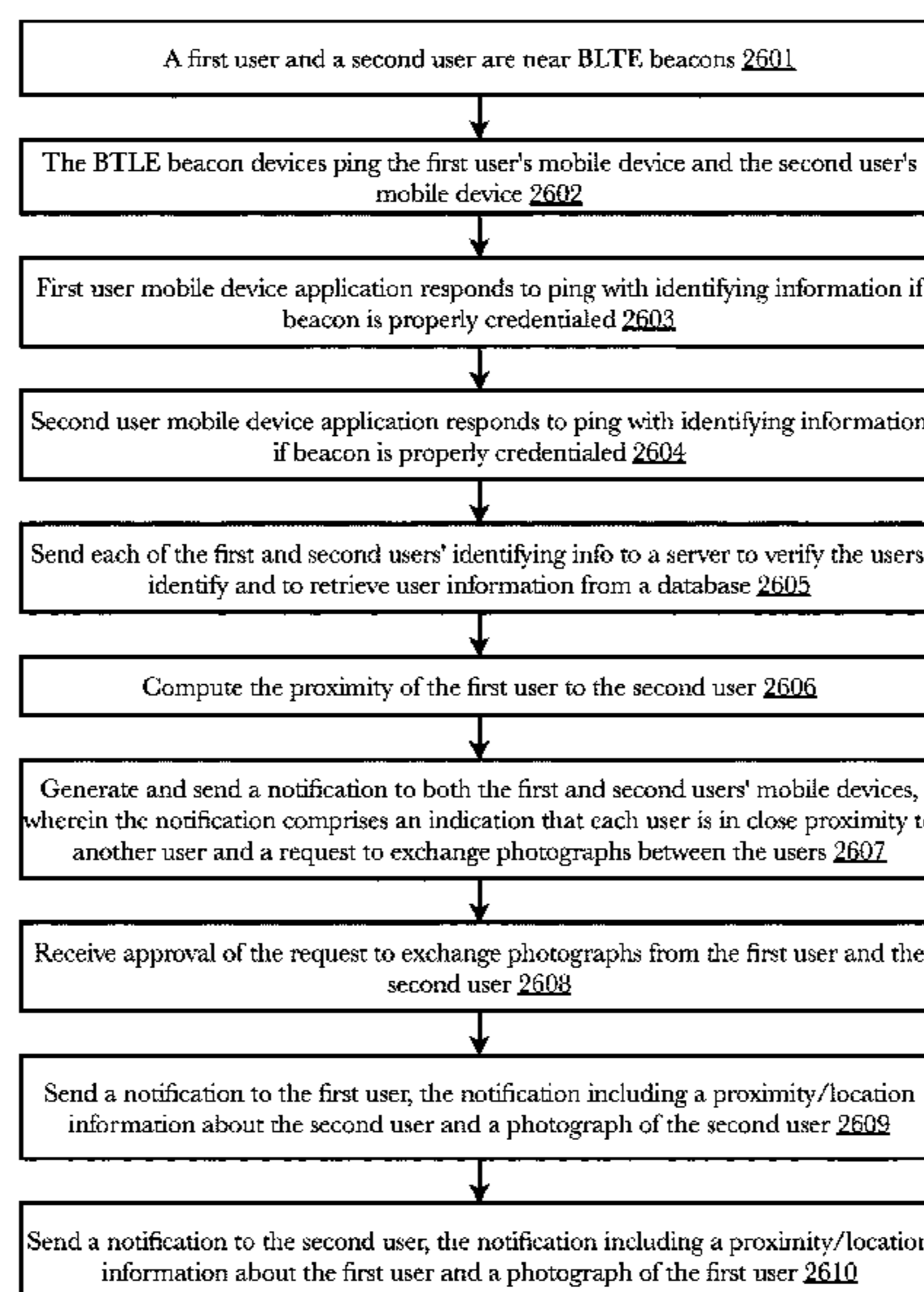
Primary Examiner — Tuyen K Vo

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(57) **ABSTRACT**

A system and methods for zero-step proximity detection and private matchmaking using mobile device low emissions beacons, which uses user mobile devices, a single or plurality of BLUETOOTH™ low-emissions (BTLE) beacons, a network, a server, and an application that may operate separately on a mobile device and the single or plurality of BLUETOOTH™ low-emissions (BTLE) beacons, which calculates the proximity between two or more users, which allows users to be alerted to other users in their proximity, and which provide a means for verifying and managing meetups between two or more users of the mobile devices.

16 Claims, 26 Drawing Sheets



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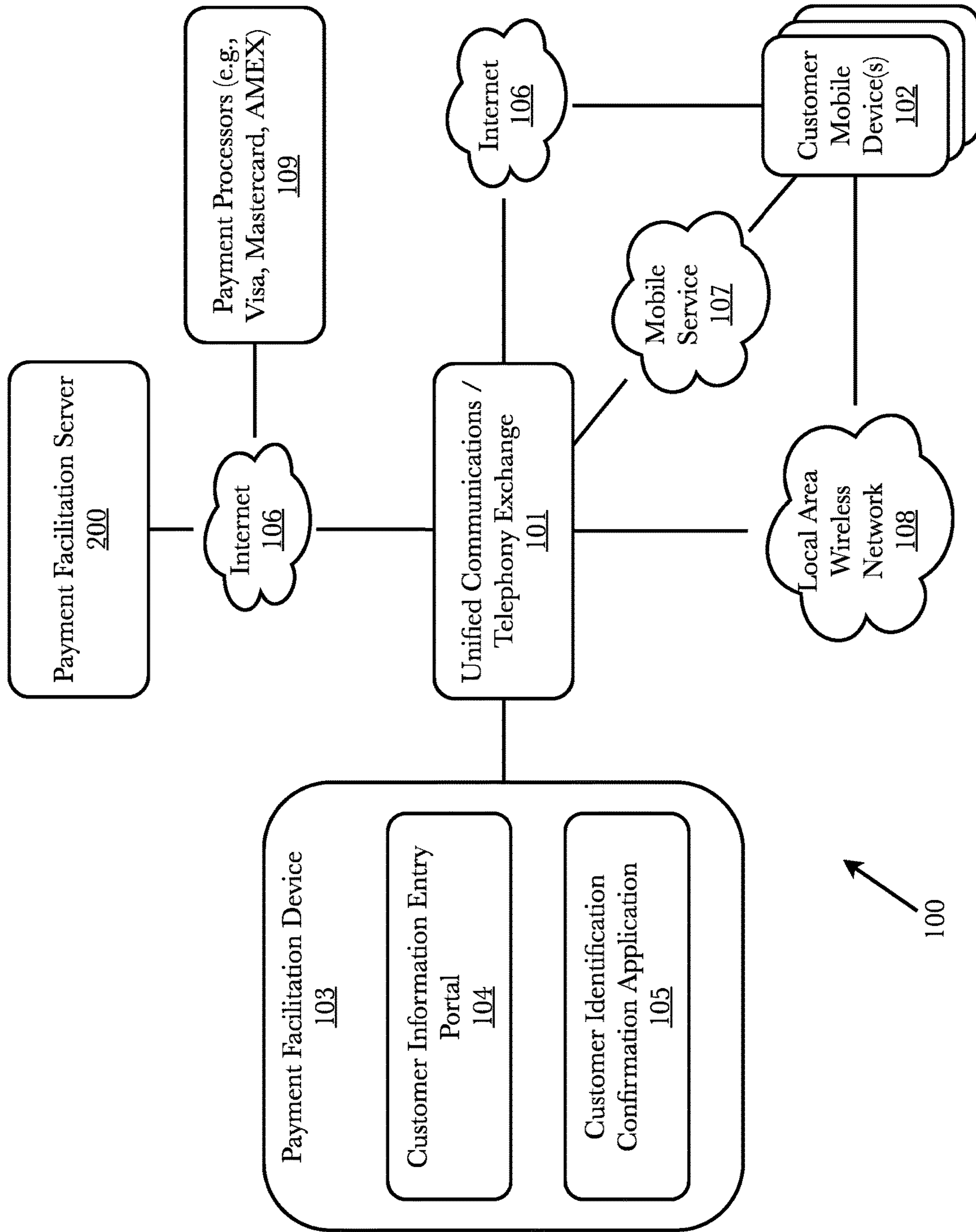


Fig. 1

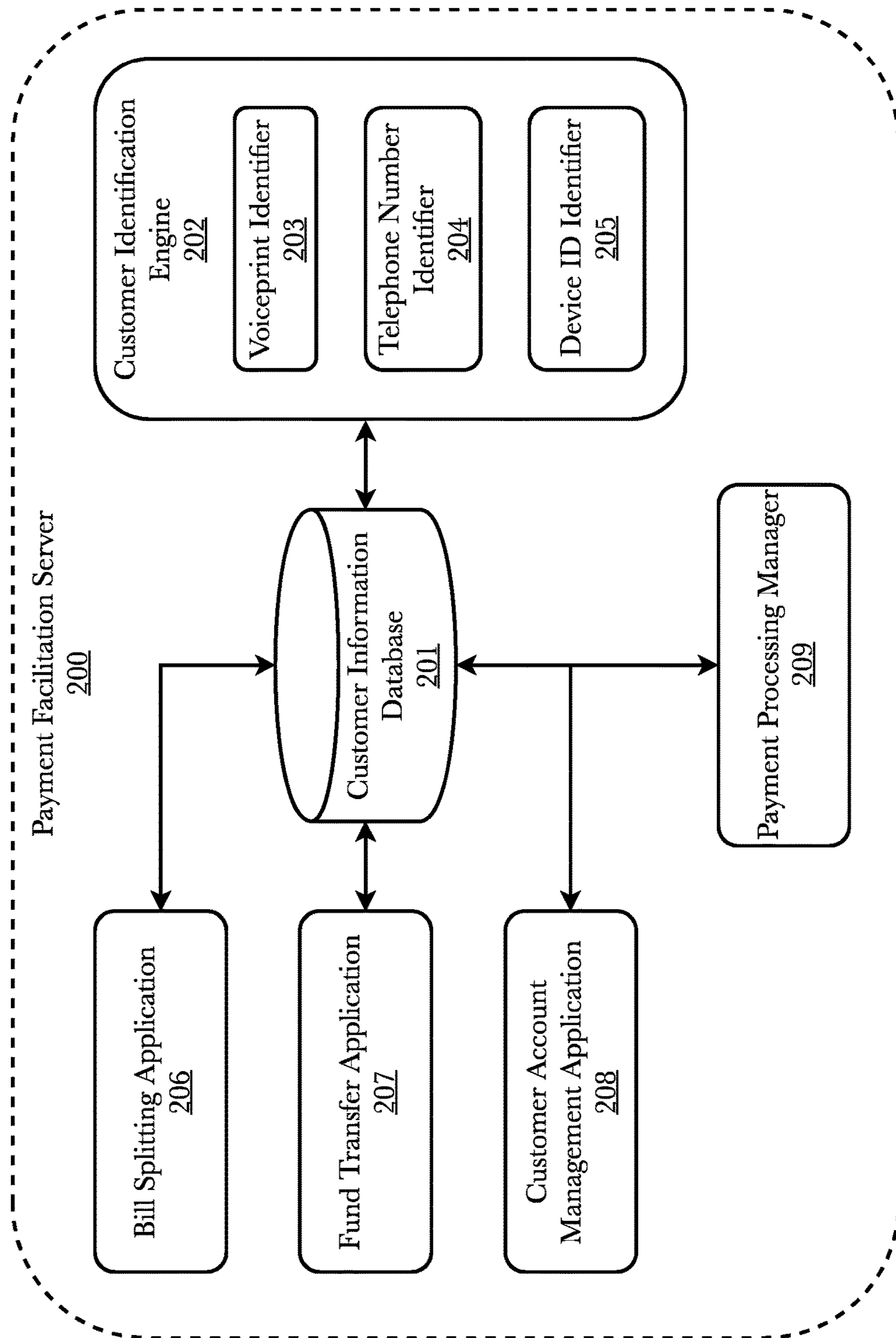


Fig. 2

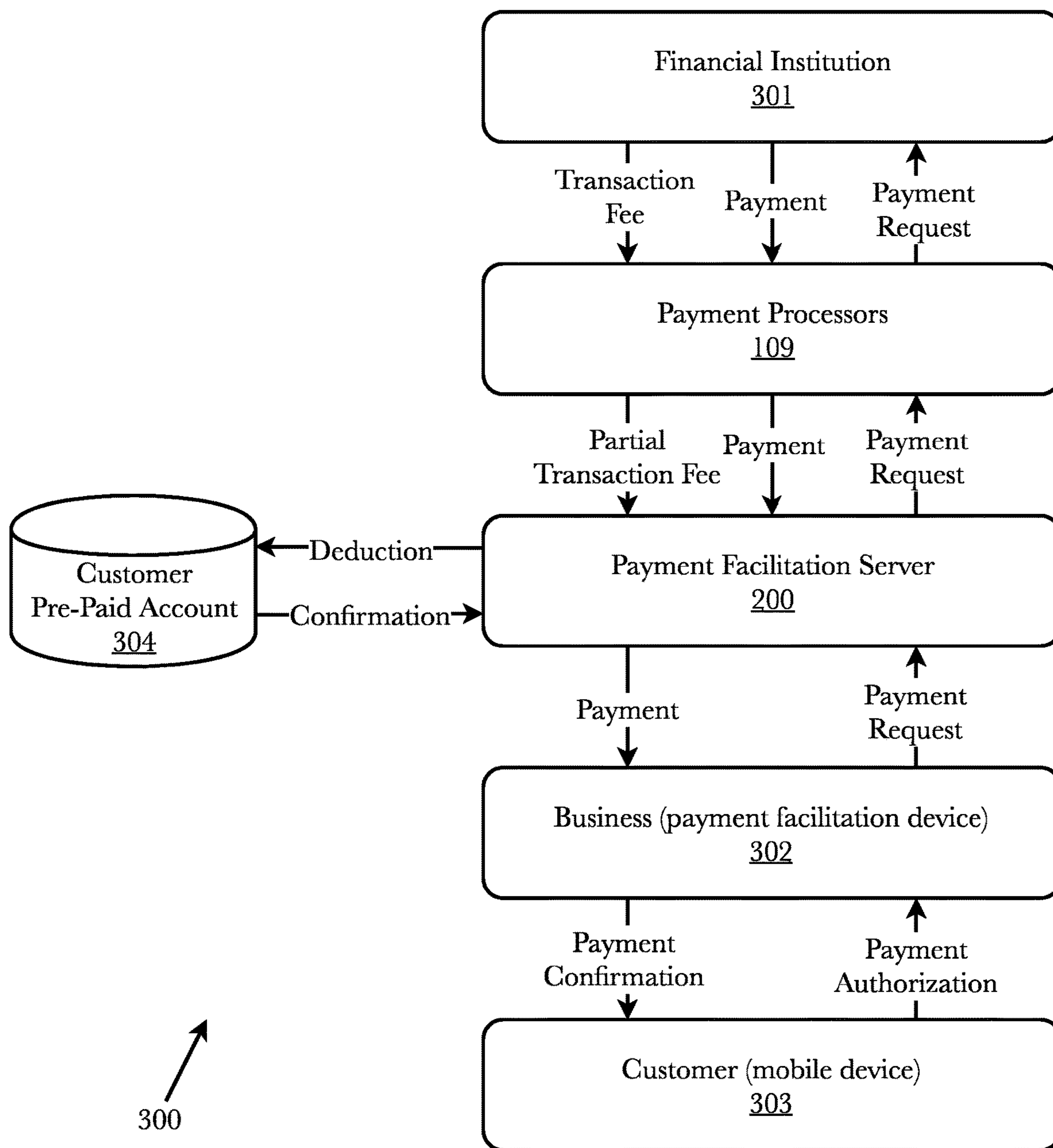


Fig. 3

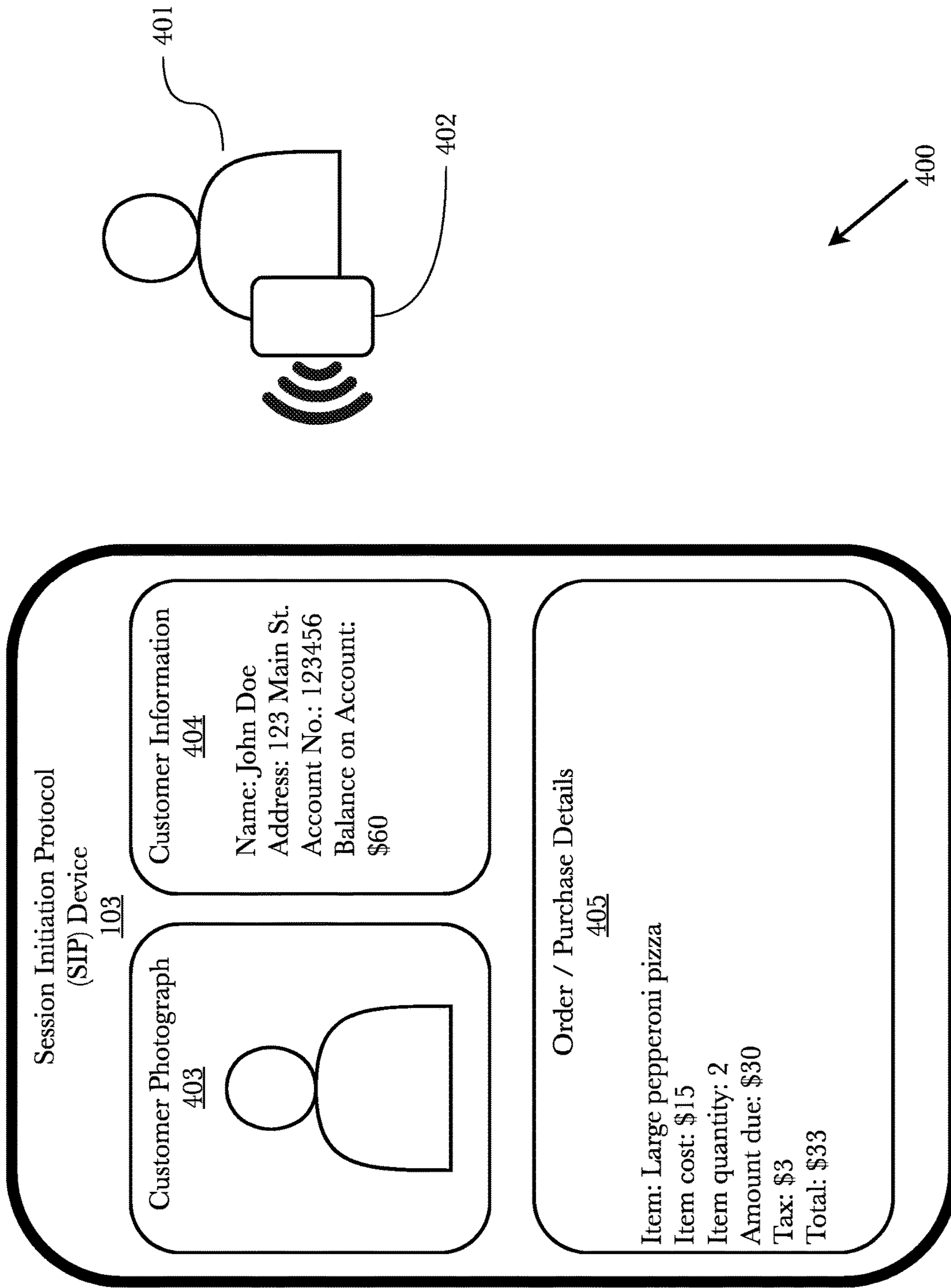


Fig. 4

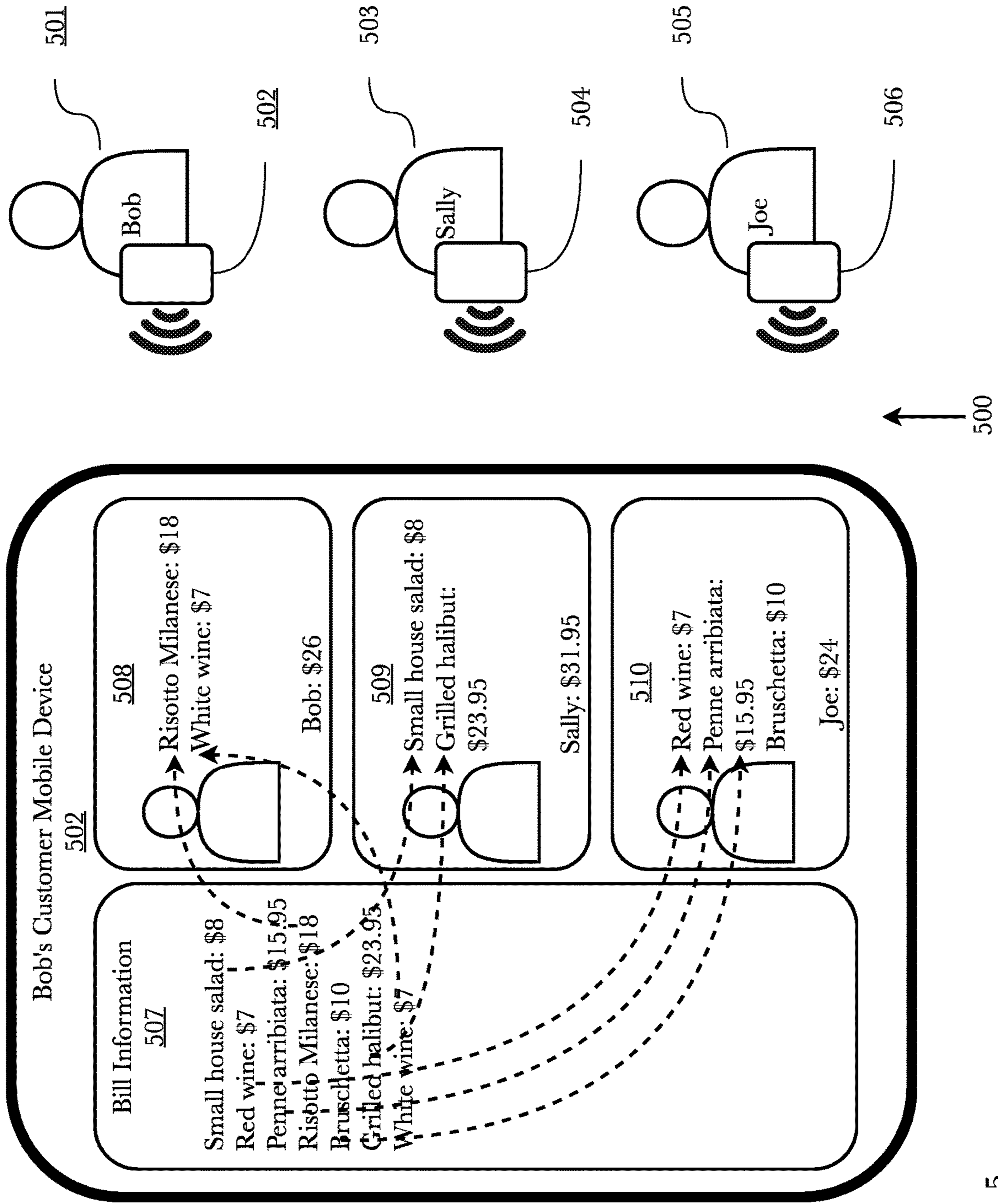


Fig. 5

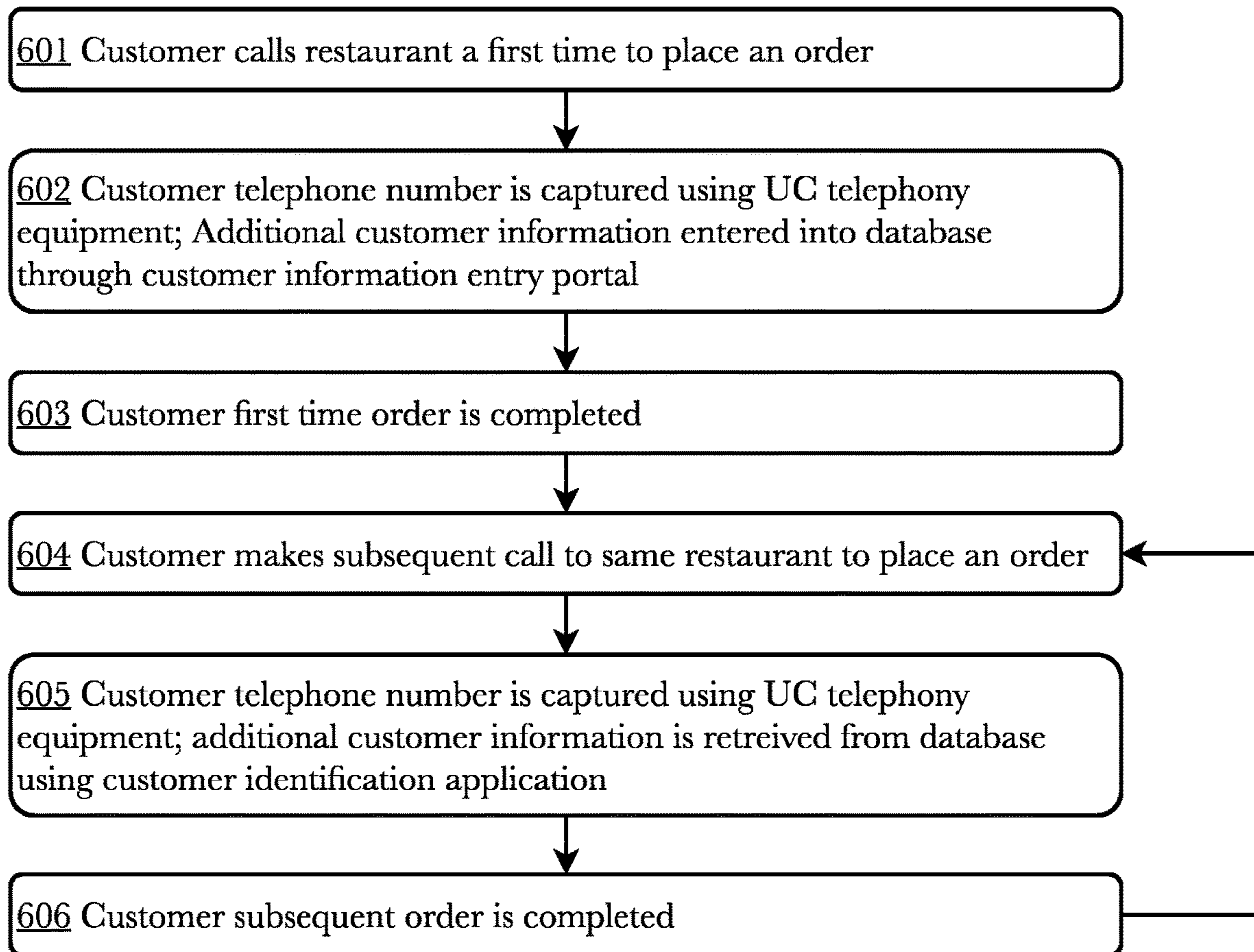


Fig. 6

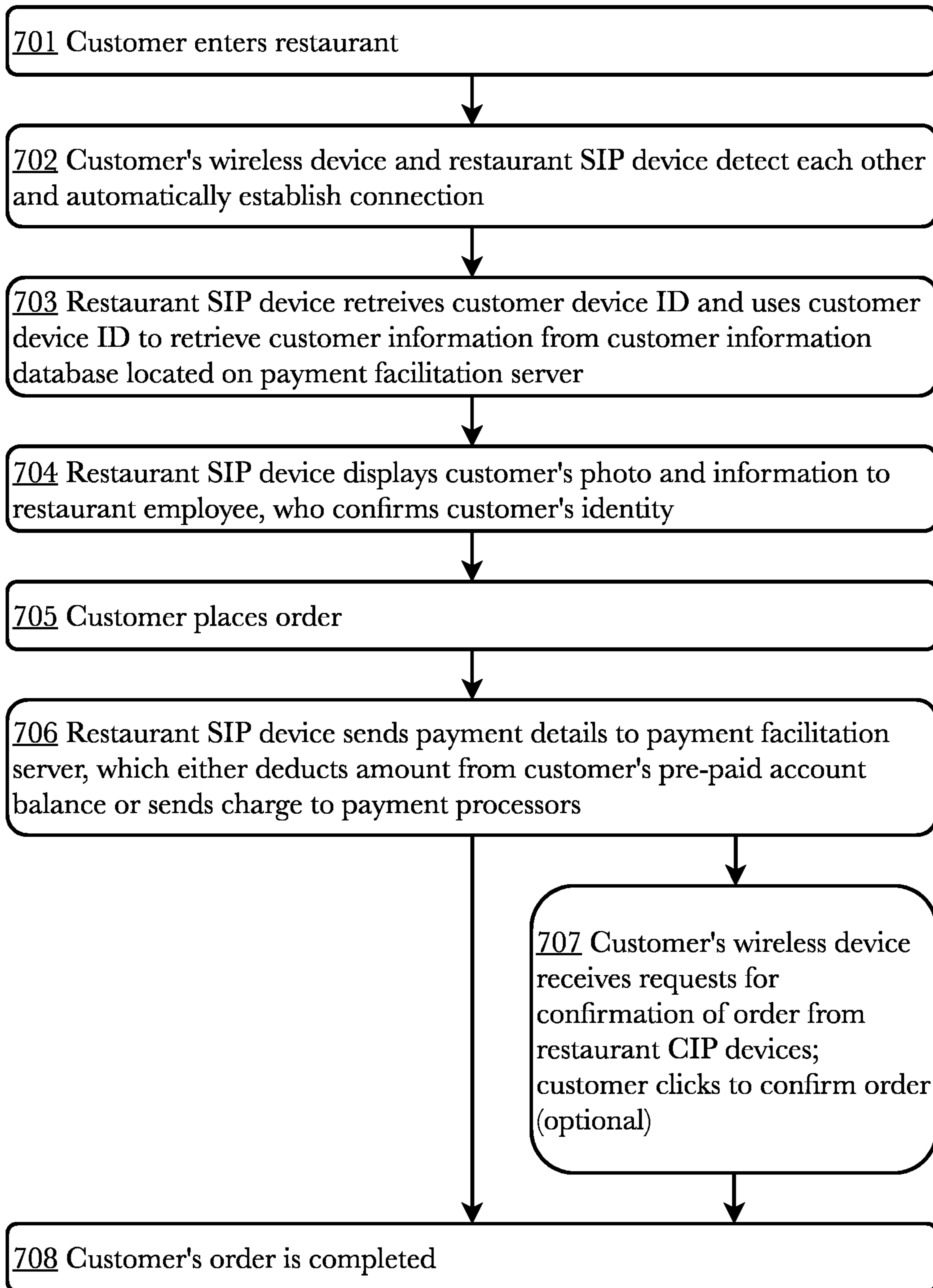


Fig. 7

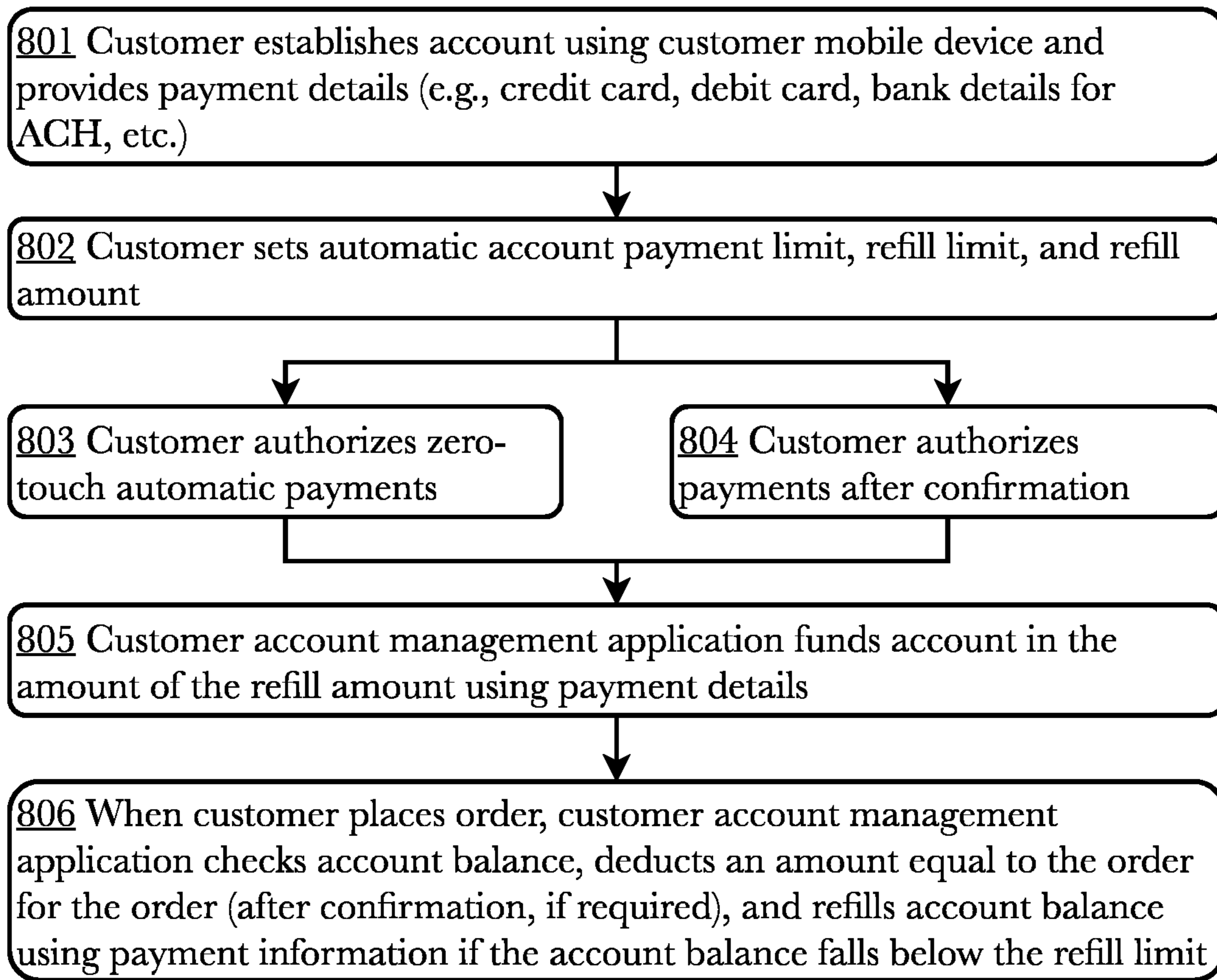


Fig. 8

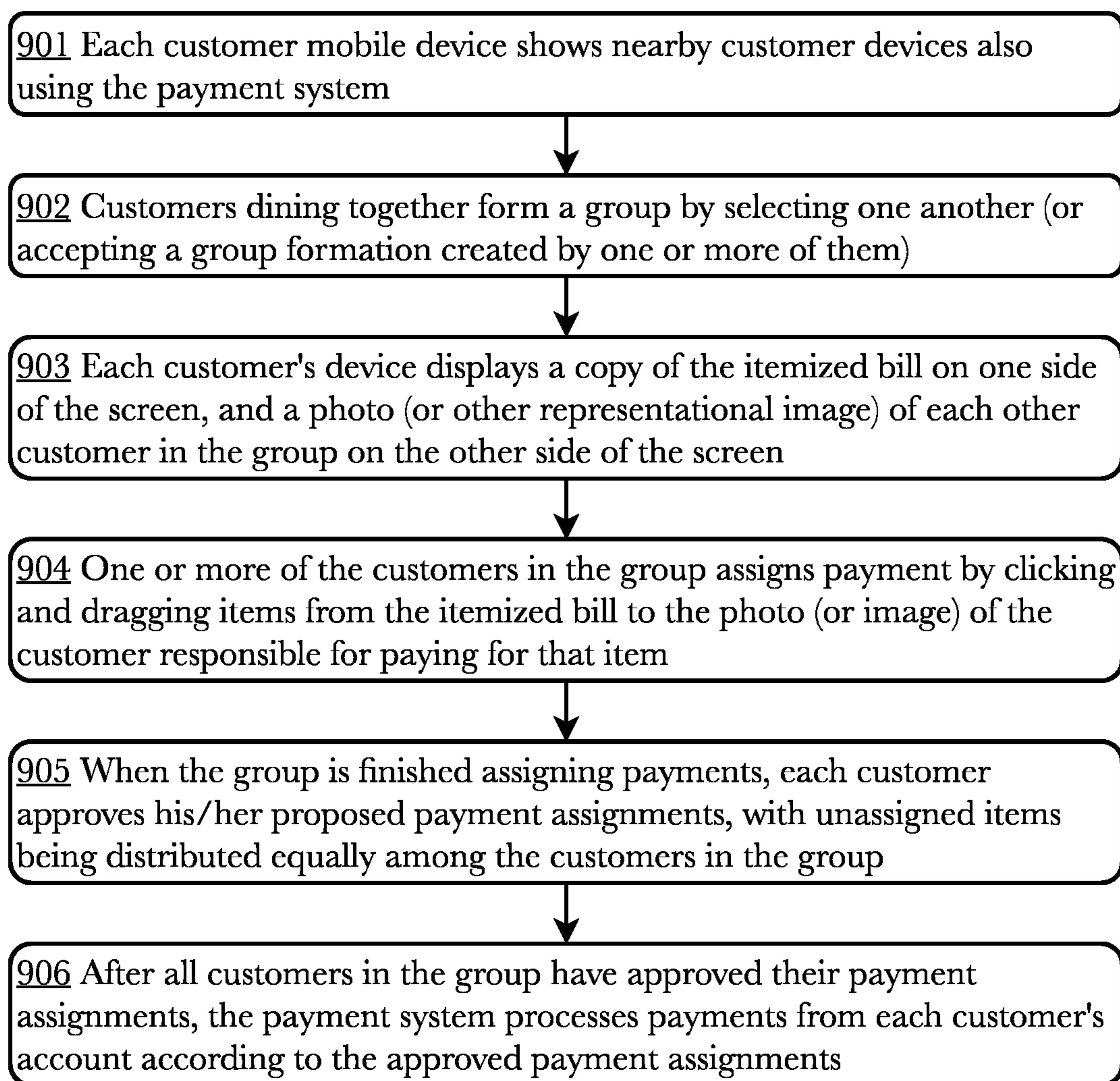


Fig. 9

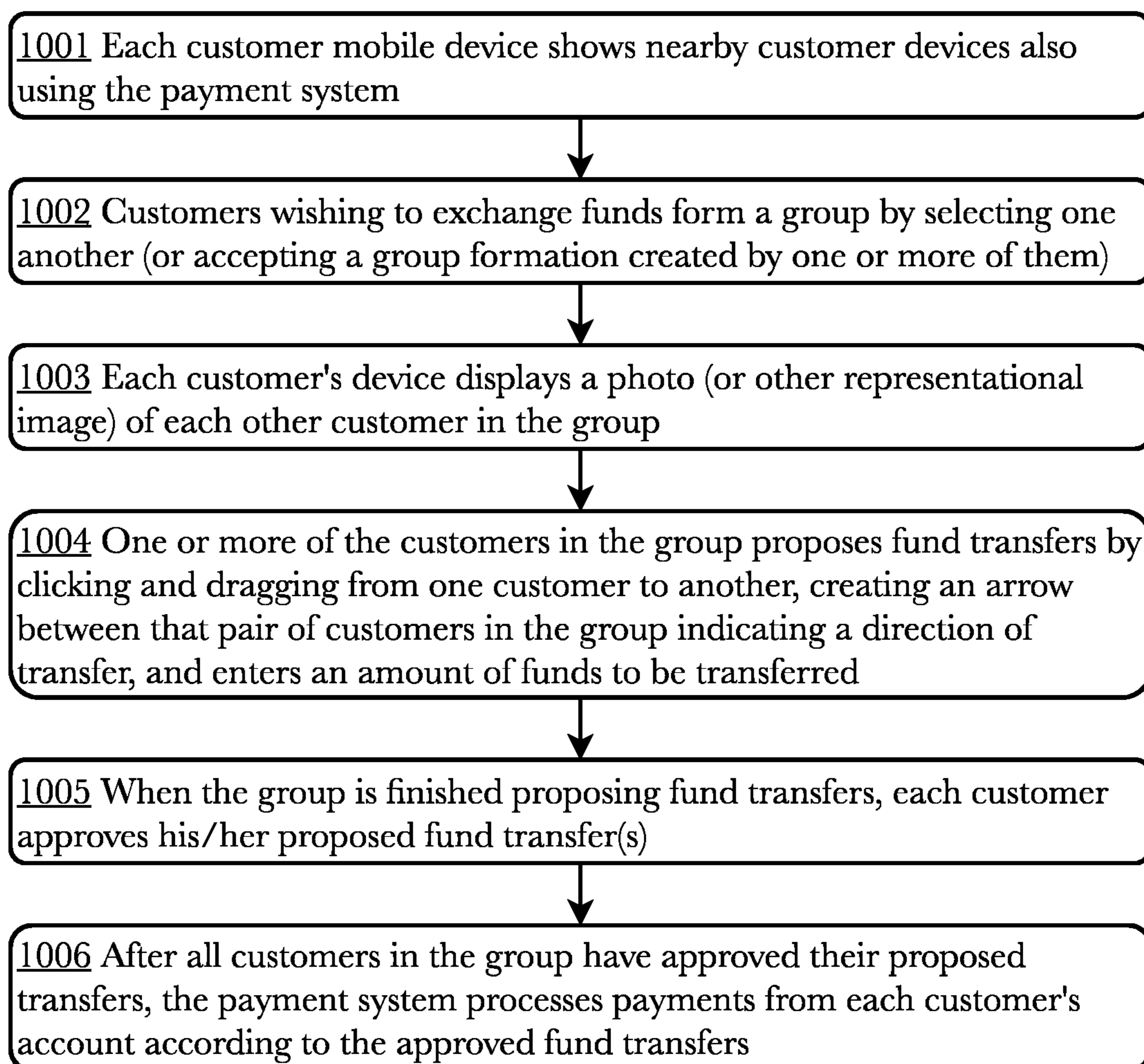


Fig. 10

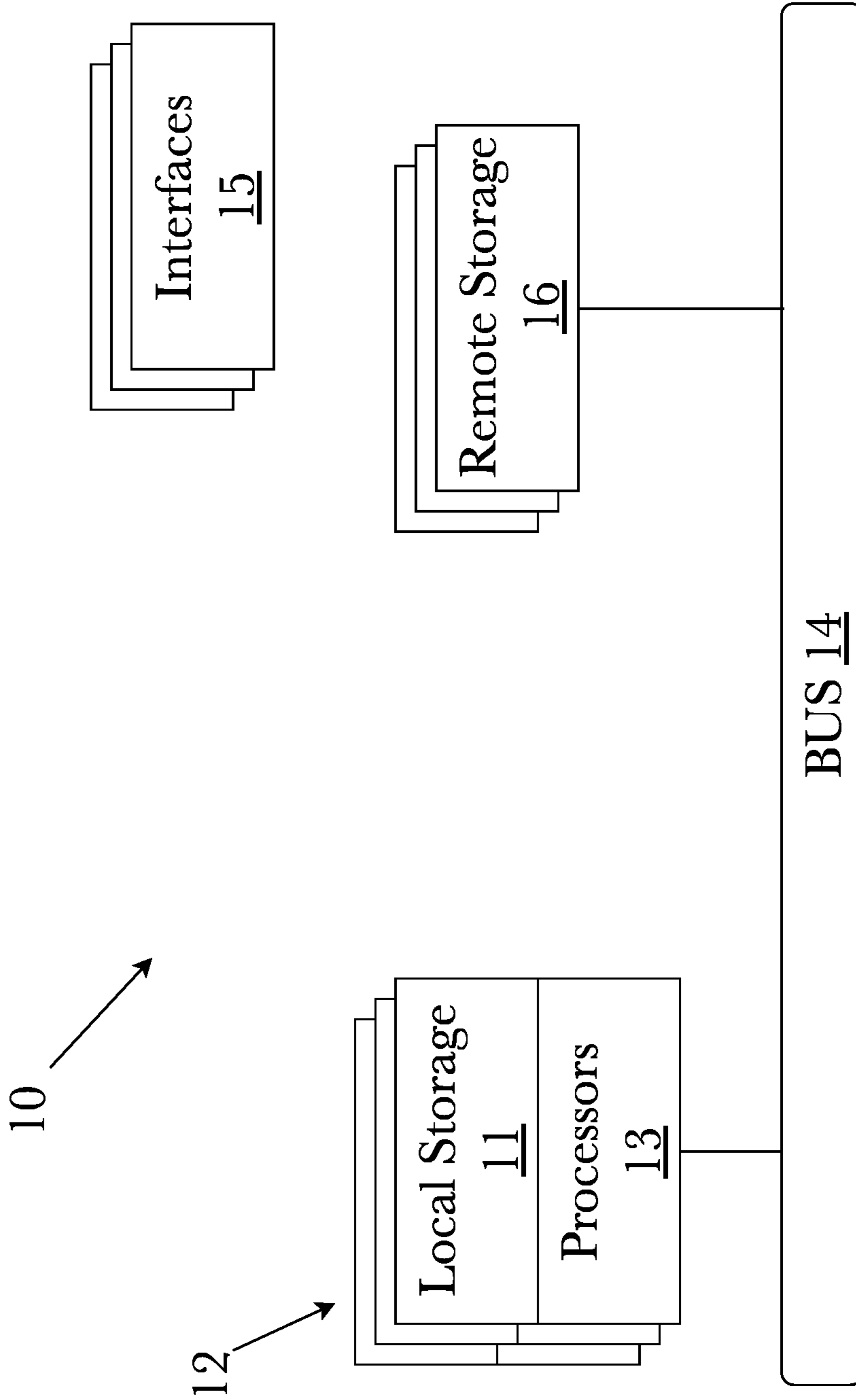


Fig. 11

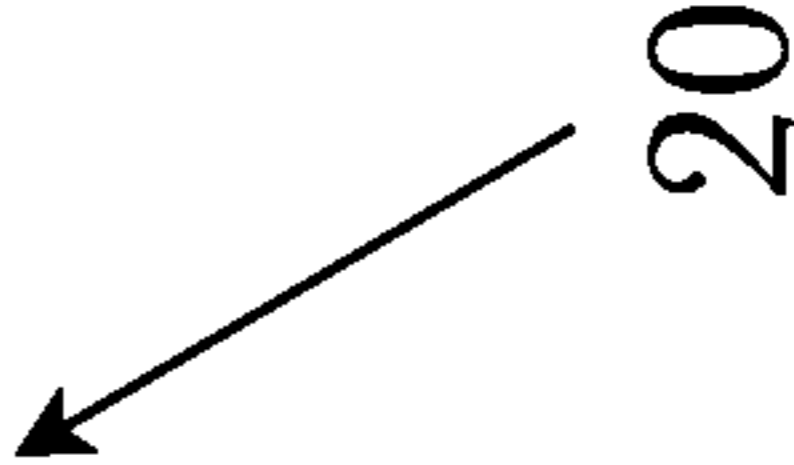
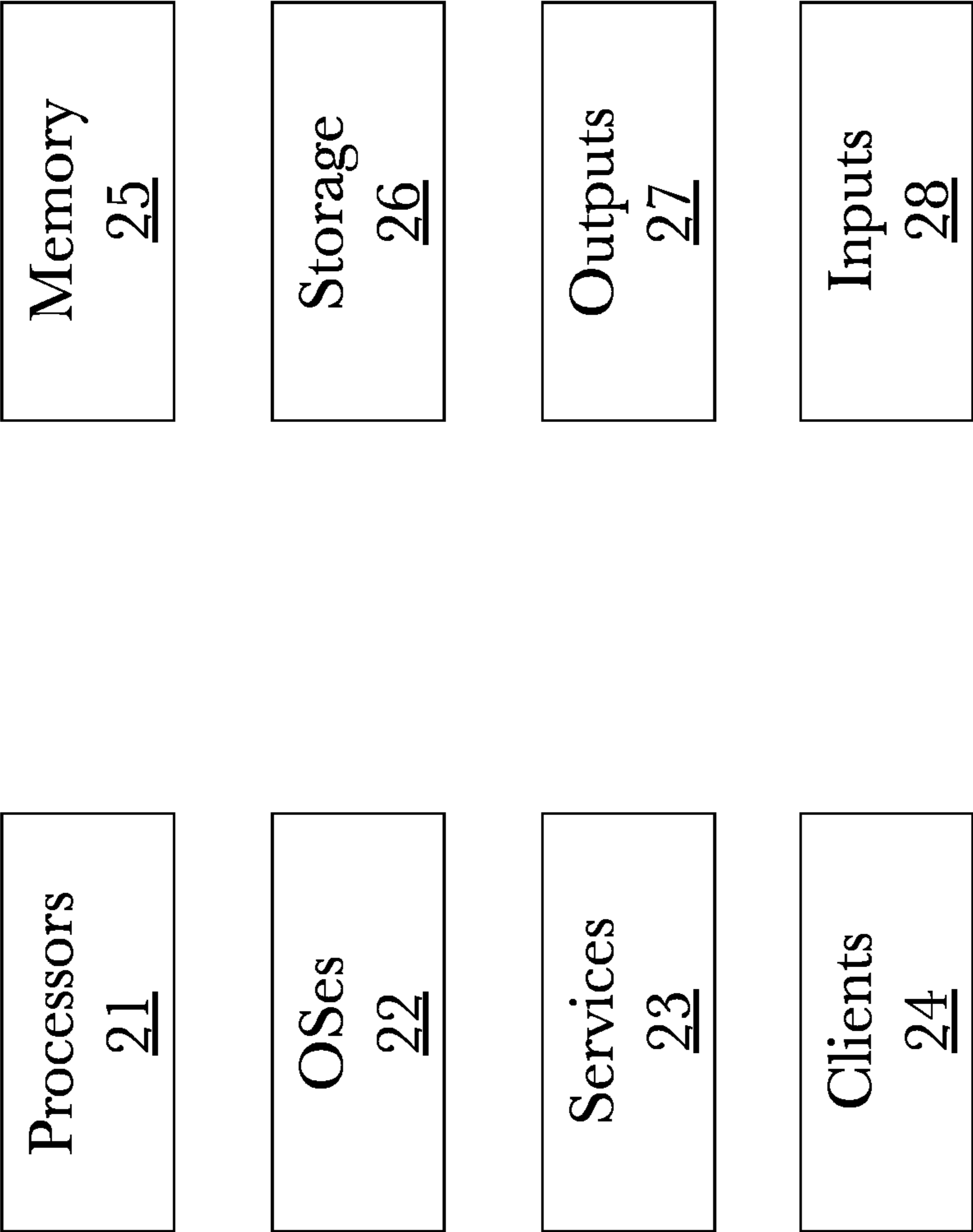


Fig. 12

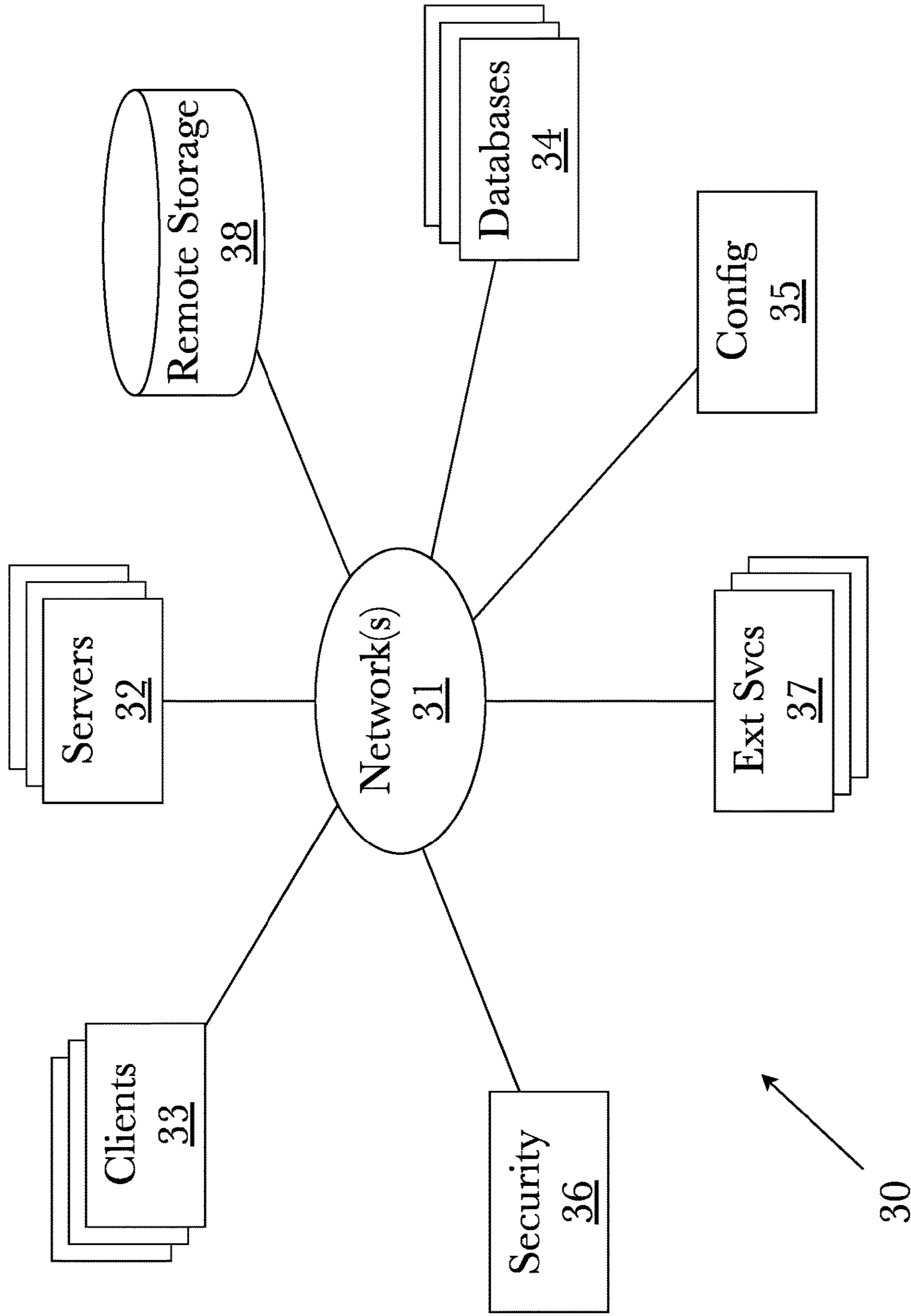


Fig. 13

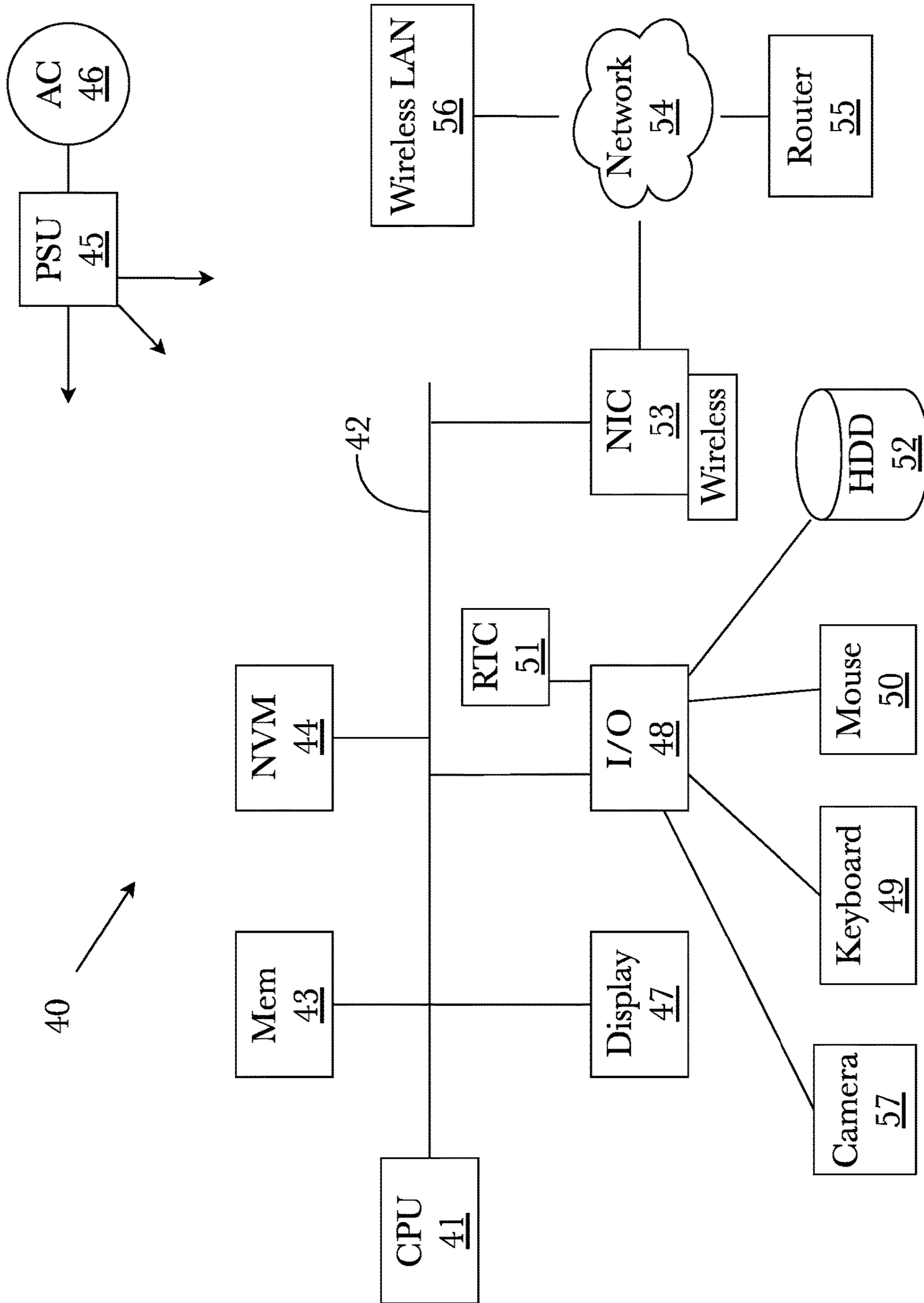


Fig. 14

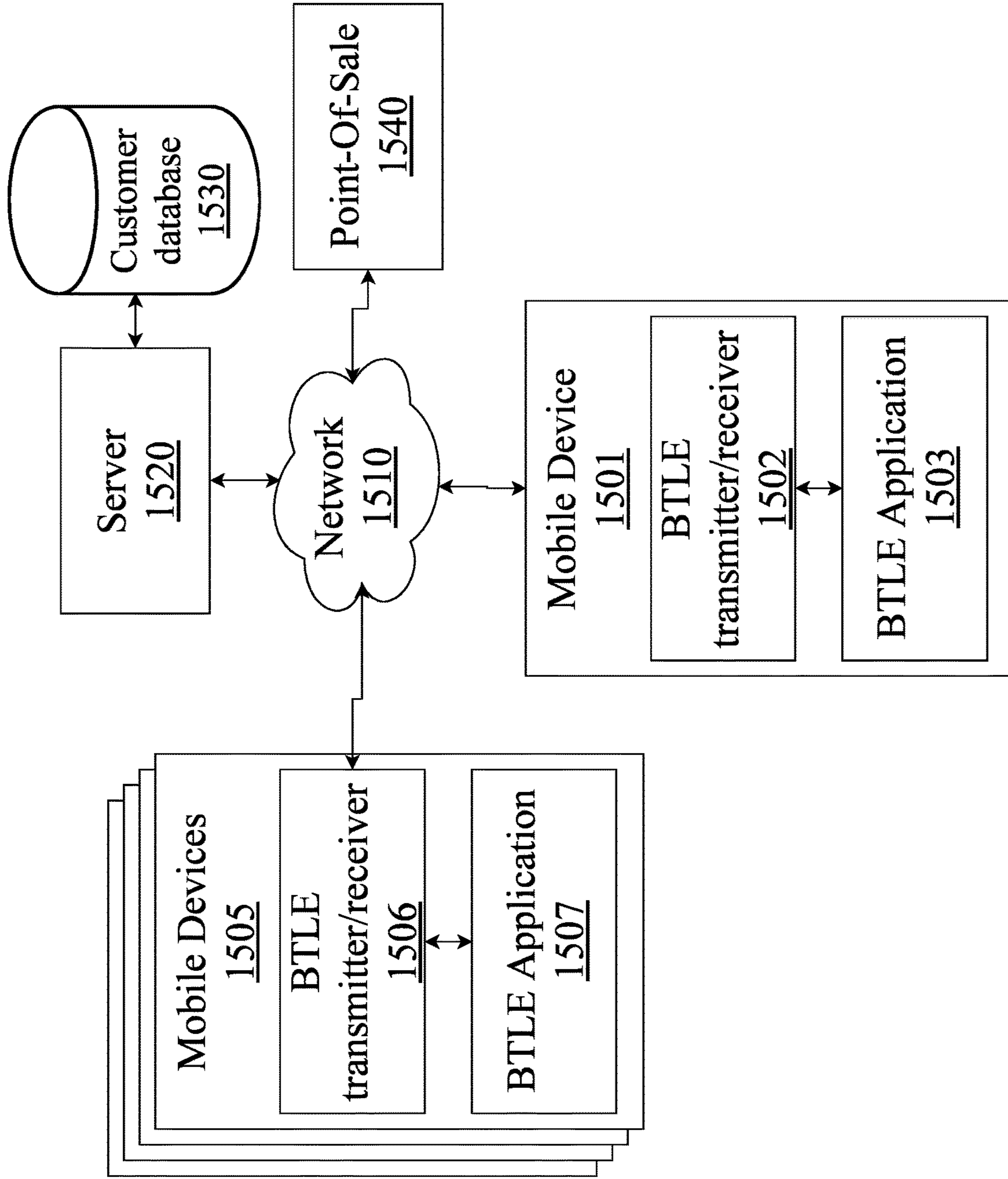


Fig. 15

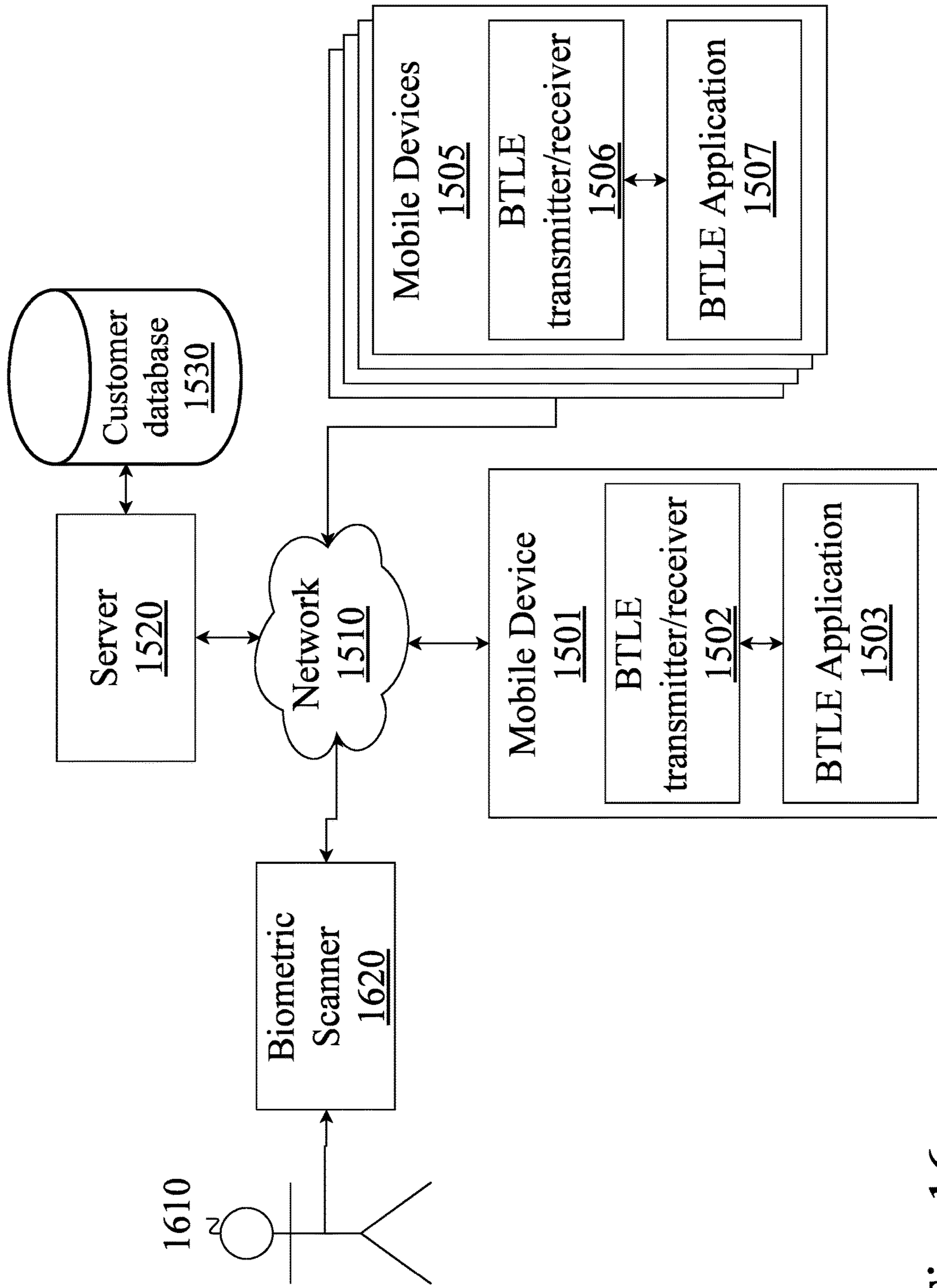


Fig. 16

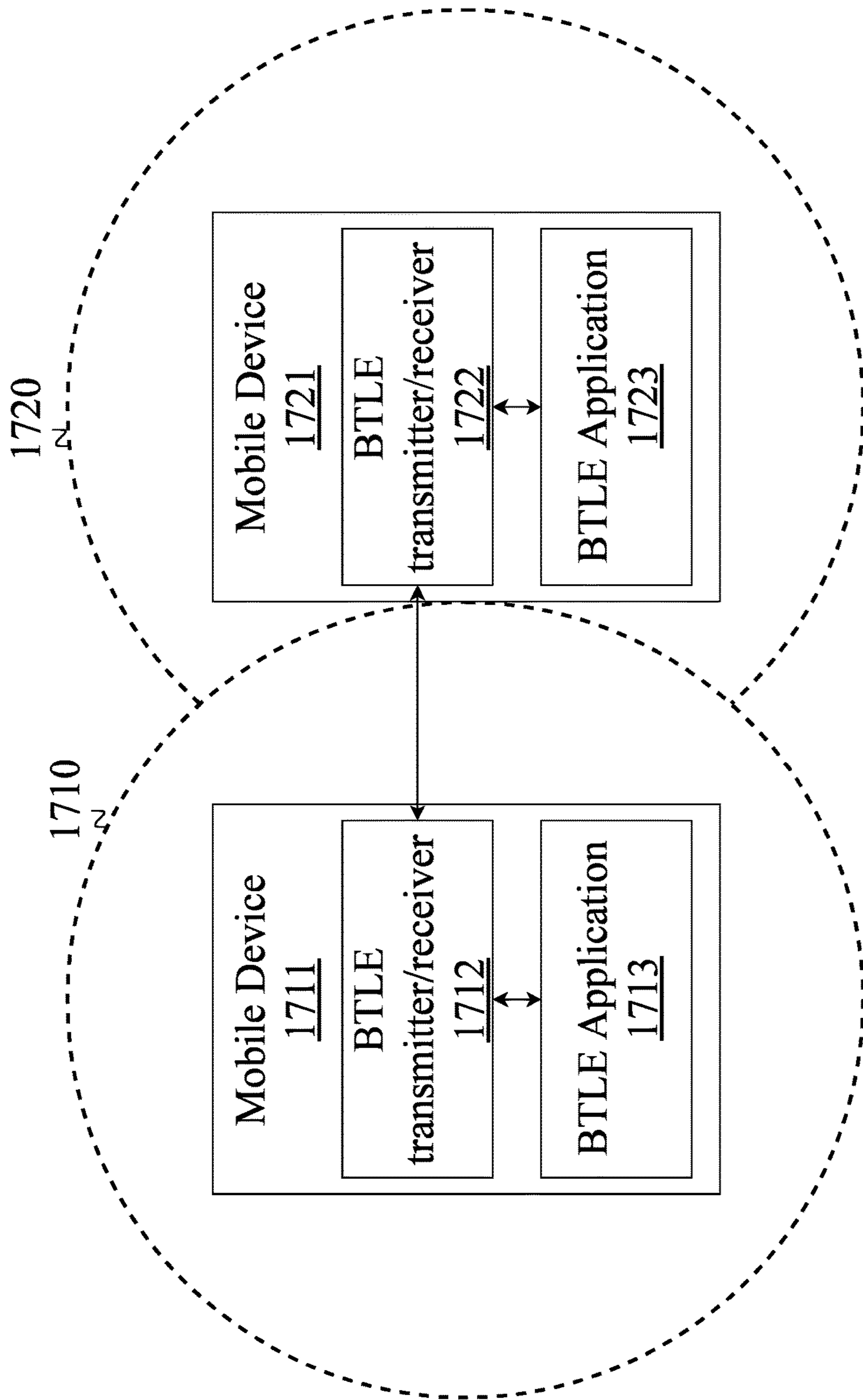


Fig. 17

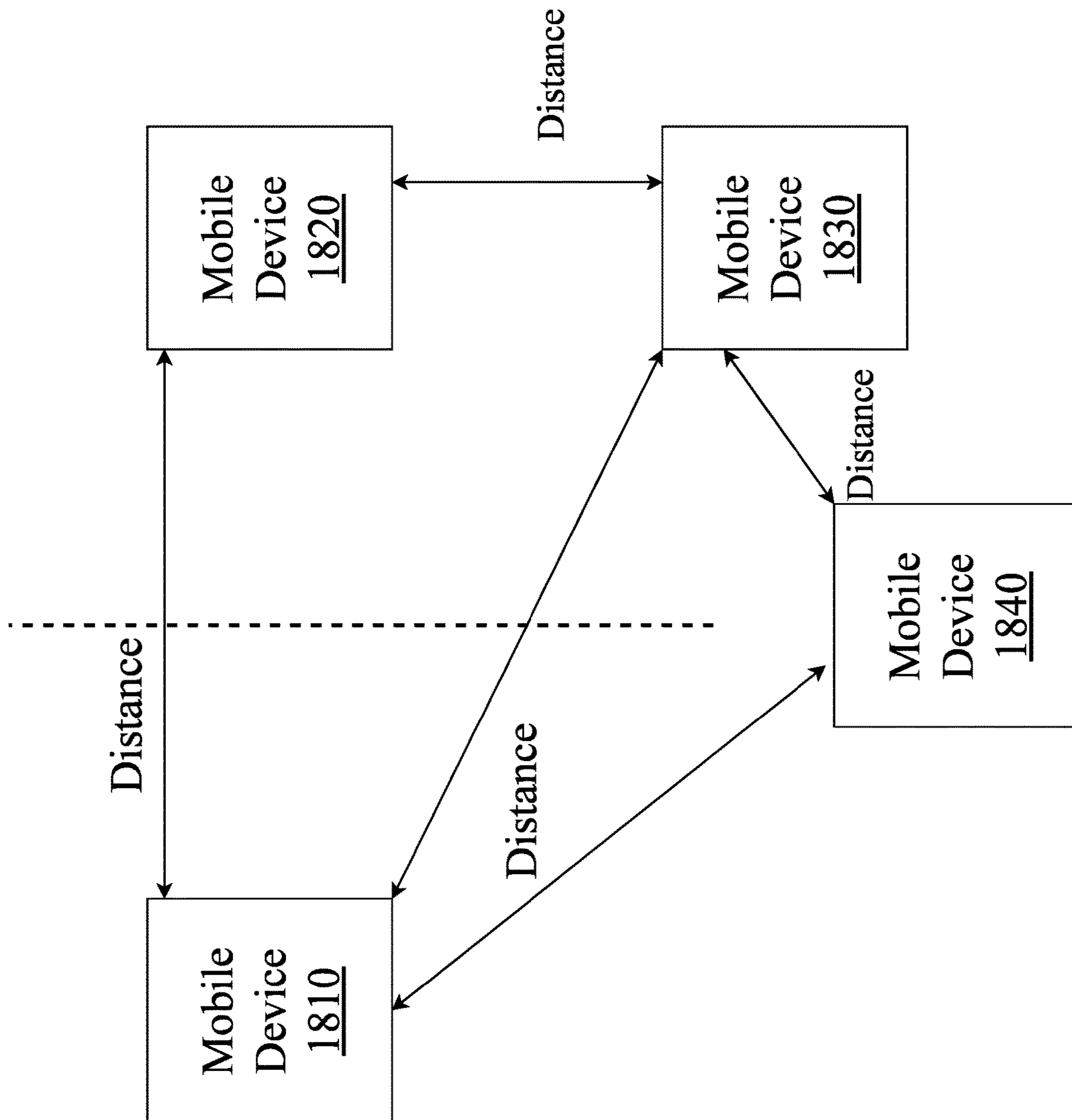


Fig. 18

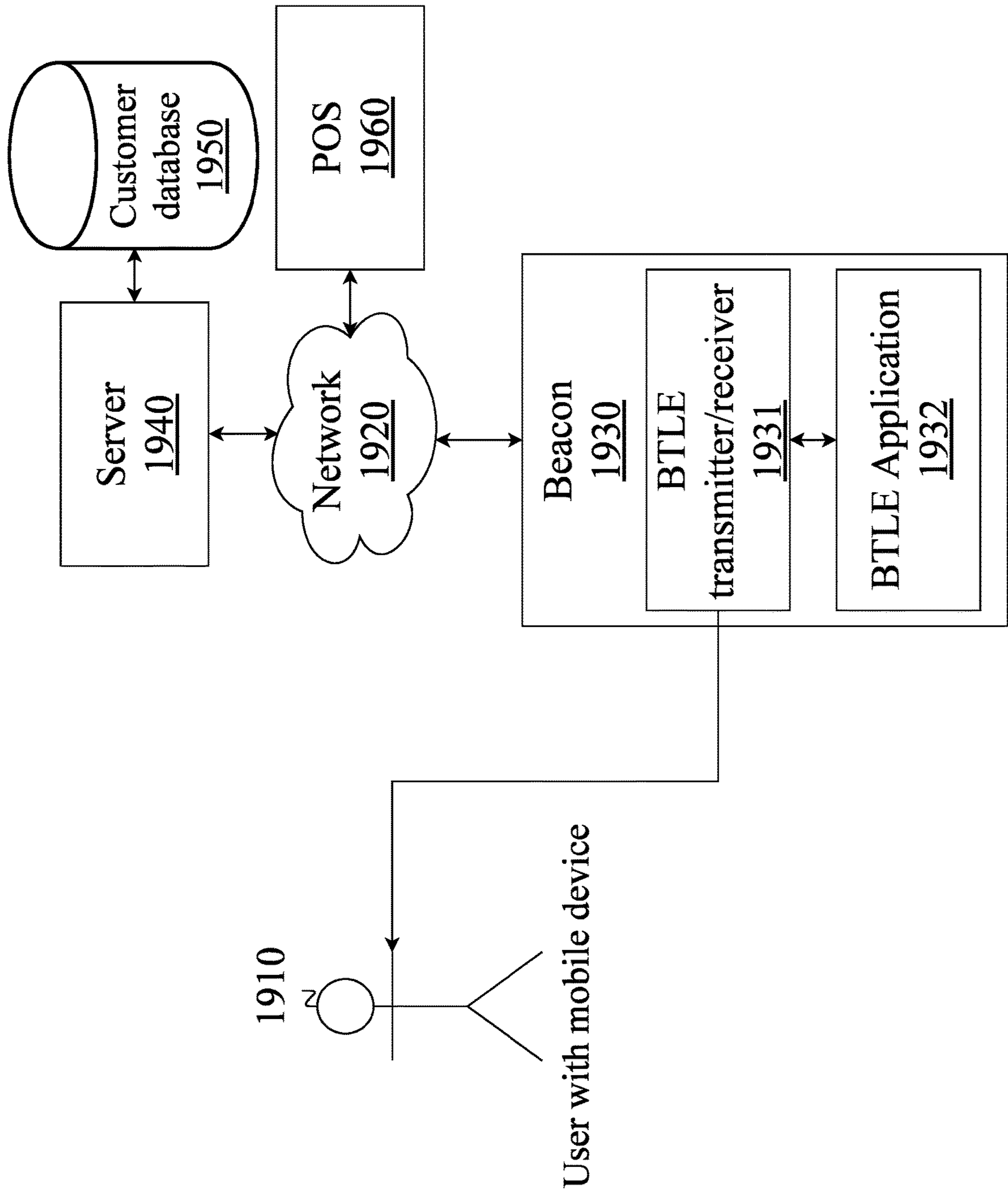


Fig. 19

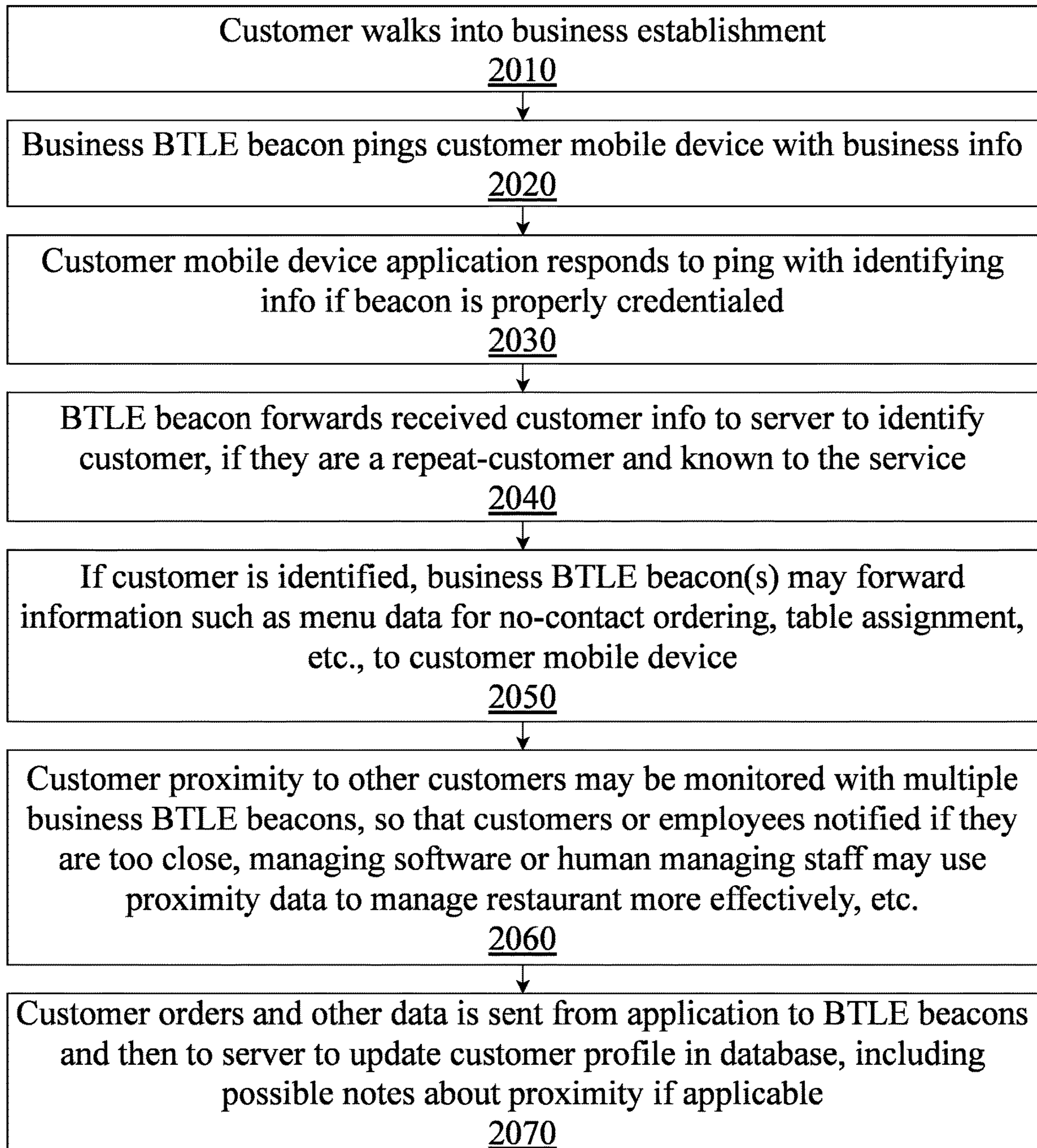


Fig. 20

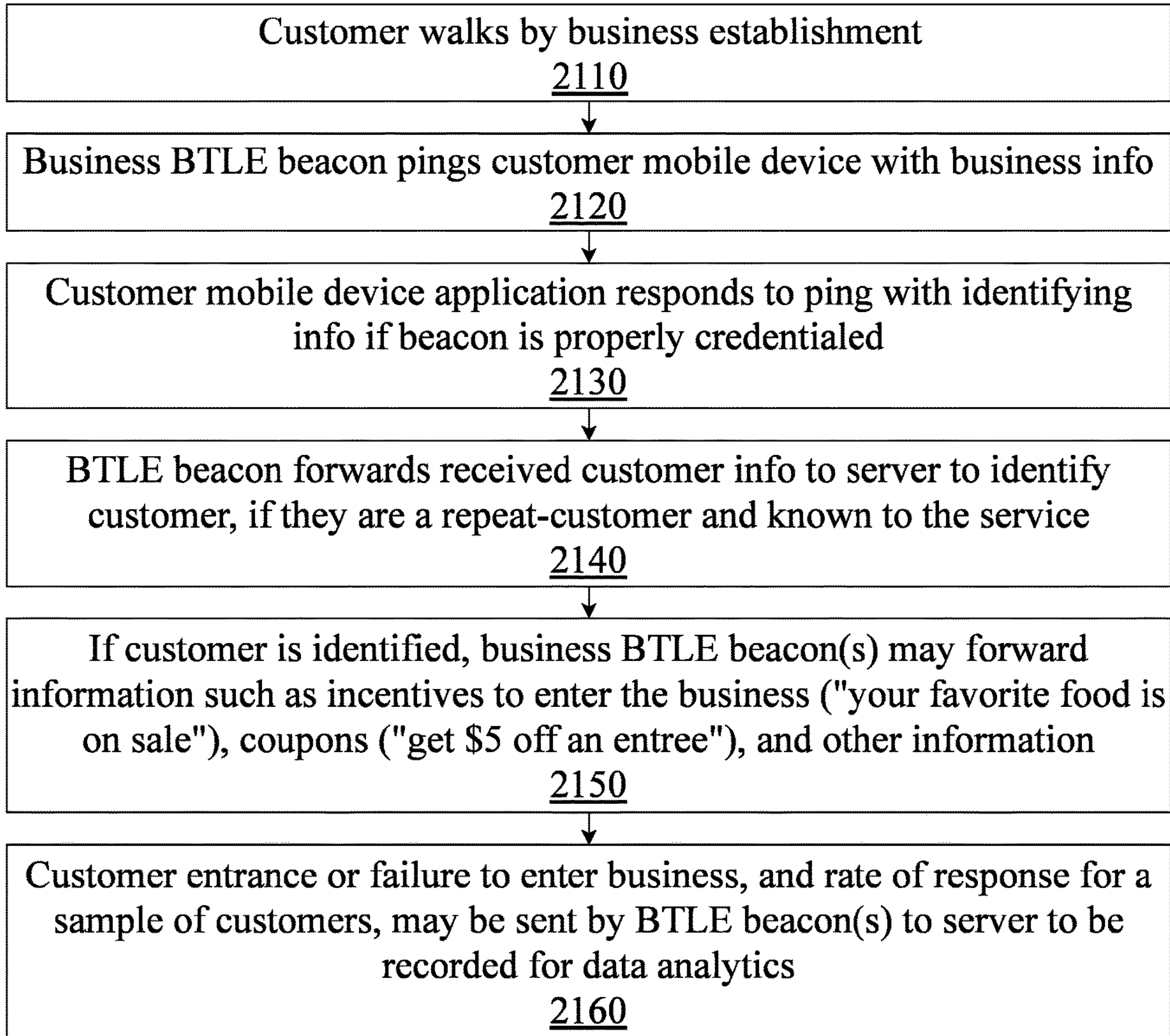


Fig. 21

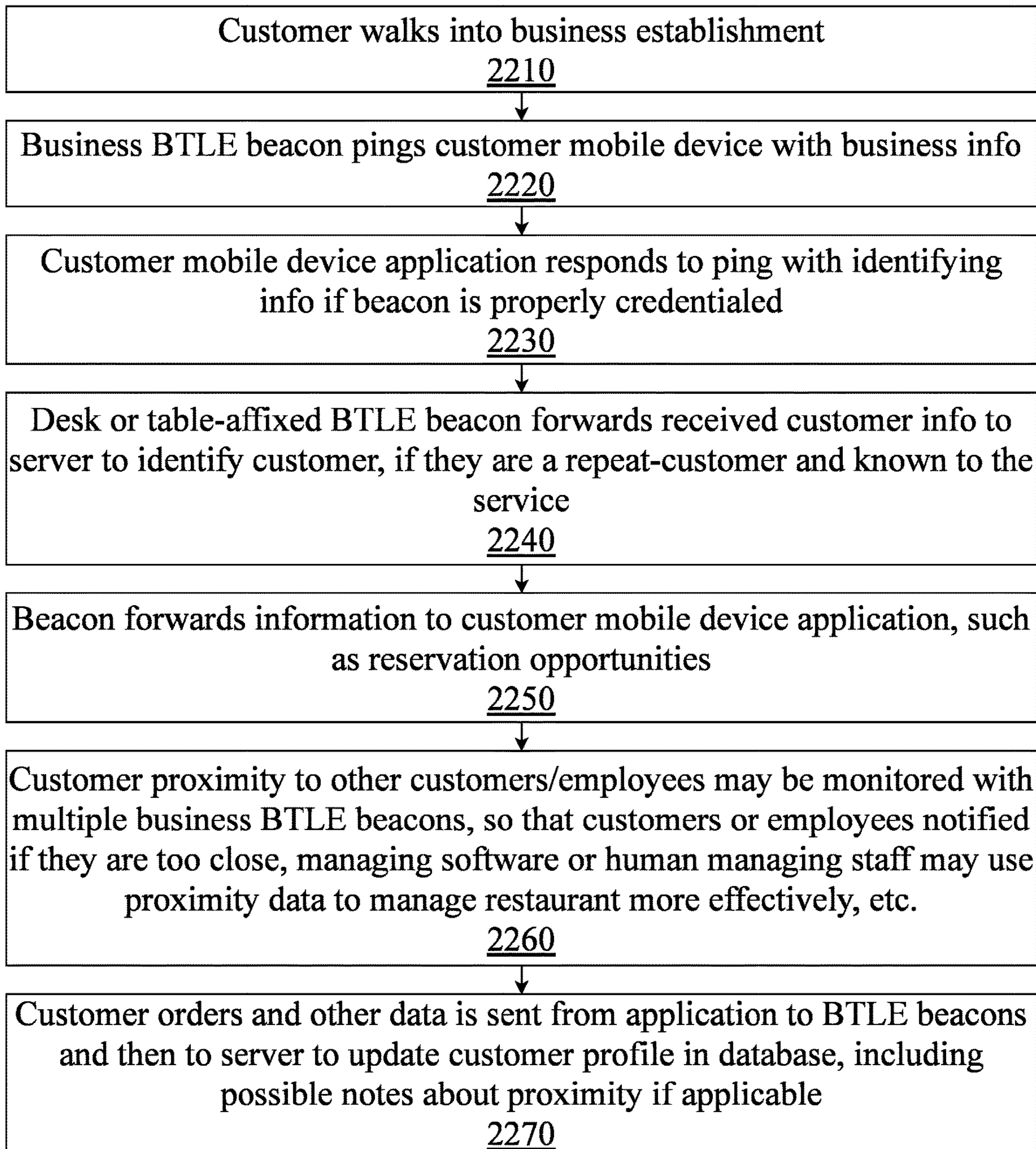


Fig. 22

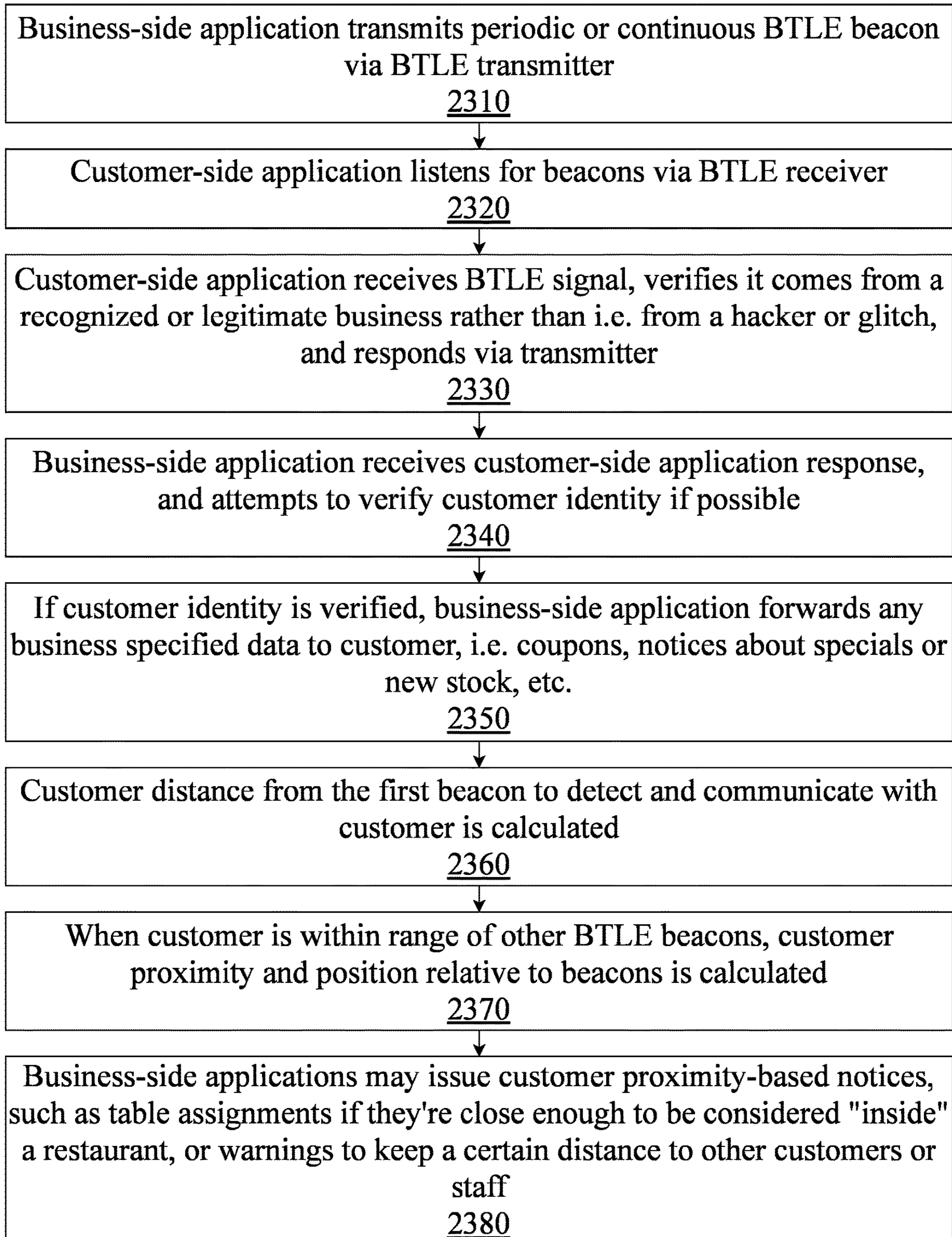


Fig. 23

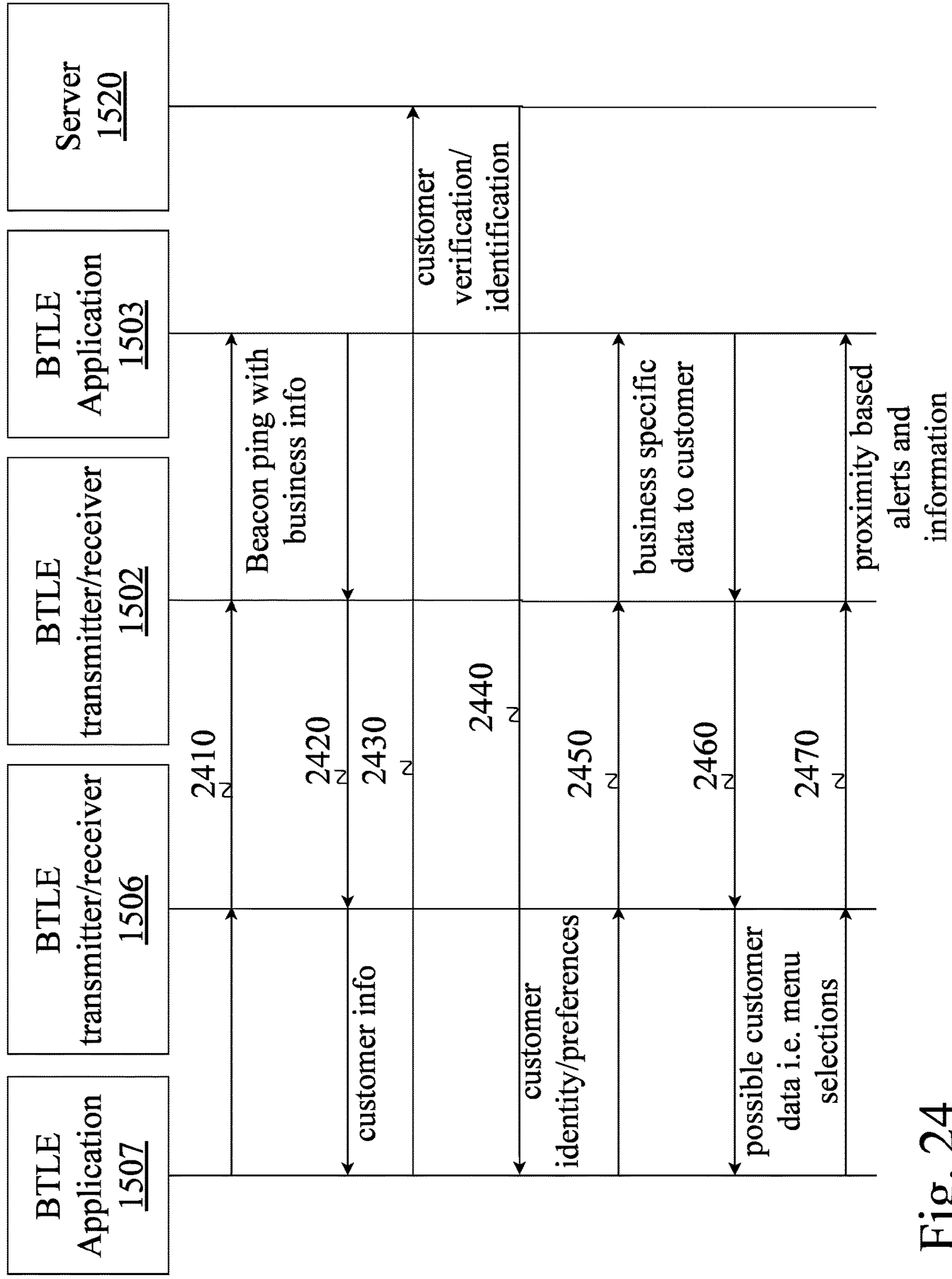


Fig. 24

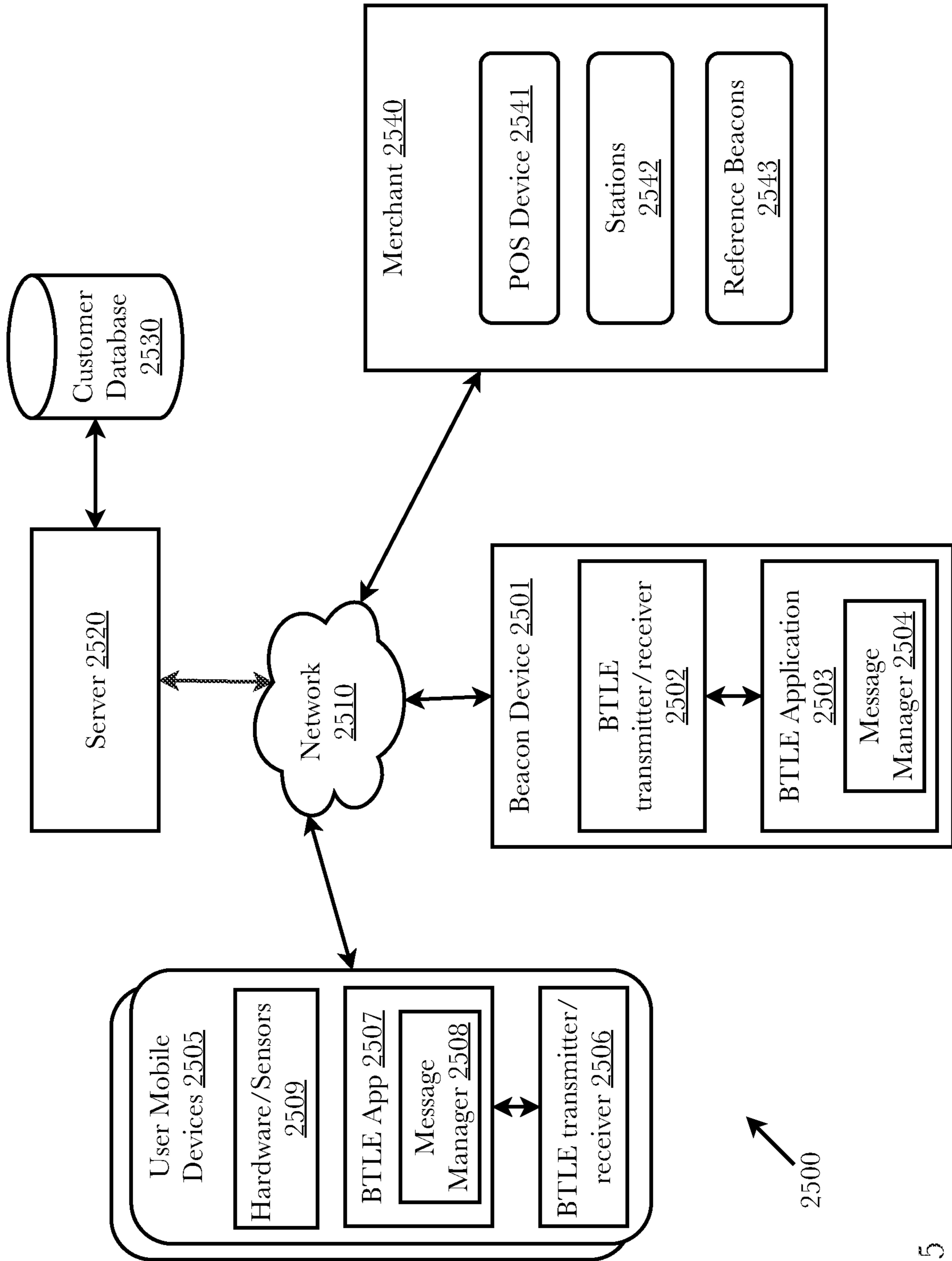


Fig. 25

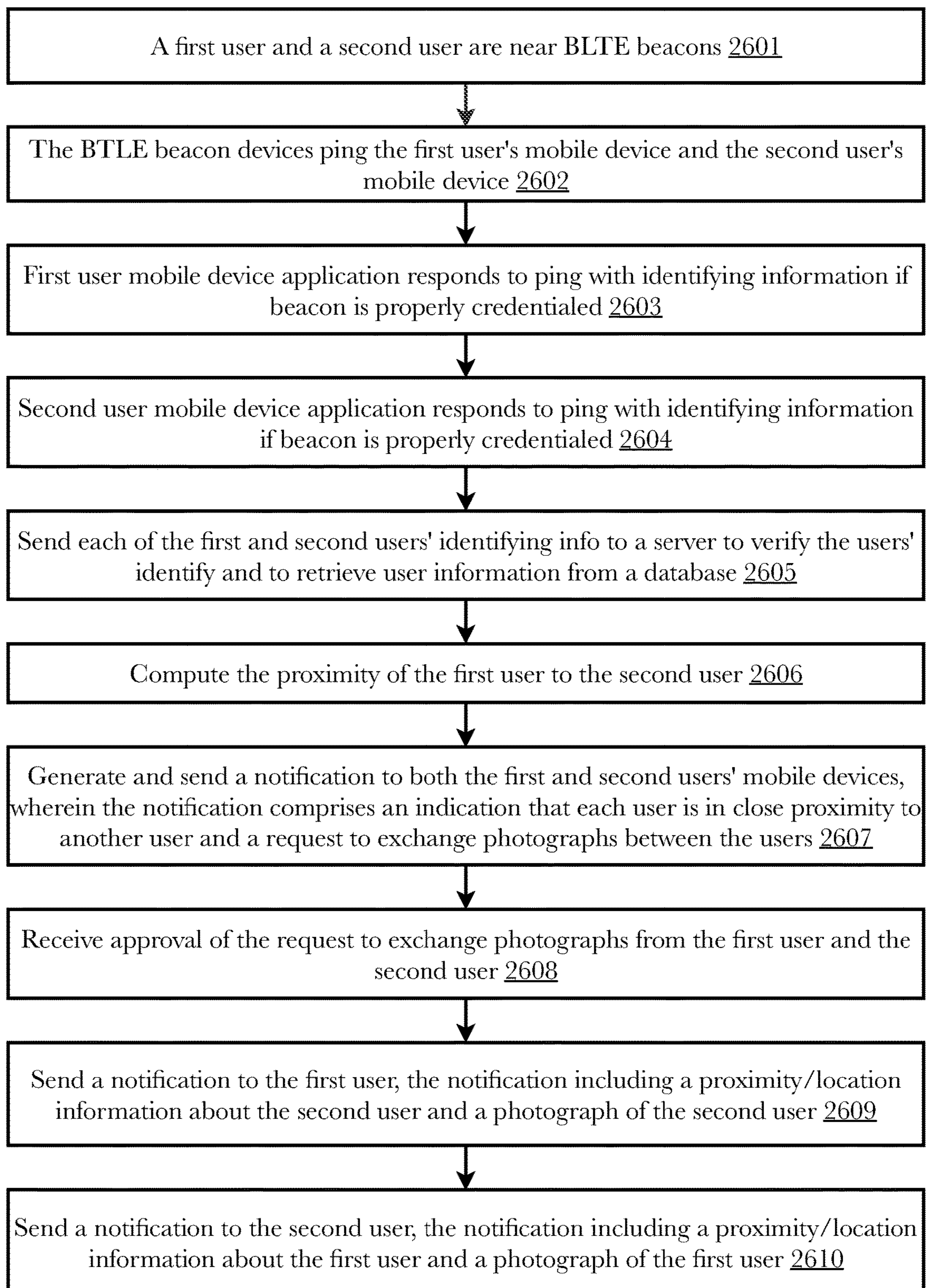


Fig. 26

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**SYSTEM AND METHOD FOR ZERO-STEP
PROXIMITY DETECTION AND PRIVATE
MATCHMAKING USING MOBILE DEVICE
LOW EMISSIONS BEACONS**

CROSS-REFERENCE TO RELATED
APPLICATIONS

Priority is claimed in the application data sheet to the following patents or patent applications, the entire written description of each of which is expressly incorporated herein by reference in its entirety:

Ser. No. 17/091,925
63/070,895
Ser. No. 17/005,038
62/964,413
Ser. No. 16/796,342
62/938,817

BACKGROUND

Field of the Art

The disclosure relates to the field of automated customer service systems, and more particularly to the field of customer proximity detection and communications using wireless-enabled mobile devices.

Discussion of the State of the Art

Wireless mobile computing devices (e.g., smartphones) have enabled wireless payment technologies wherein the consumer makes a payment by receiving a payment request on the customer's mobile device and authorizing the payment by tapping an icon on the screen. However, no technologies have been widespread and easily adopted for the purposes of proximity detection and proximity-based messaging to customers, for the purposes of providing more intimate and accurate communications, both automated and manual, to customers, especially in the context of social distancing in situations where it is imperative customers remain outside of certain proximities of other customers and of employees.

What is needed is a system and method for zero-step customer proximity detection and private matchmaking using mobile devices that nearly all customers already carry on their persons as it is, in a manner that entices customers and rewards them for using the system that provides this functionality, rather than being a hinderance or annoyance to customers.

SUMMARY

Accordingly, the inventor has conceived and reduced to practice, a system and methods for zero-step proximity detection and private matchmaking using mobile device low emissions beacons, which uses user mobile devices, a single or plurality of BLUETOOTH™ low-emissions (BTLE) beacons, a network, a server, and an application that may operate separately on a mobile device and the single or plurality of BLUETOOTH™ low-emissions (BTLE) beacons, which calculates the proximity between two or more users, which allows users to be alerted to other users in their proximity, and which provide a means for verifying and managing meetups between two or more users of the mobile devices.

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According to a preferred embodiment, a system for zero-step proximity detection and private matchmaking using mobile device low emissions beacons is disclosed, comprising: a wireless network beacon installed at a business location comprising a first memory, a first processor, and a first plurality of programming instructions stored in the first memory, and operating on the first processor, wherein the first plurality of programming instructions, when operating on the first processor, causes the wireless network beacon to: emit a beacon signal with short-range wireless communications; wherein the beacon signal comprises identifying information and application information associated with wireless network beacon, and a query for signal strength information; receive a first response from a first mobile device reached by the emitted beacon signal, the first response comprising a first device identifier for the first mobile device, a first signal strength of the beacon signal as received by the first mobile device, and a second signal strength of a wireless connection with a second mobile device as received by the first mobile device; receive a second response from a second mobile device reached by the emitted beacon signal, the second response comprising a second device identifier for the second mobile device, a third signal strength of the beacon signal as received by the second mobile device, and a fourth signal strength of a wireless connection with the first mobile device as received by the second mobile device; calculate by triangulation relative distances between the wireless network beacon, the first mobile device, and the second mobile device using the first, second, third, and fourth signal strengths; send the first device identifier and second device identifier to a remote computer server; receive from the remote computer server a first photograph associated with the first mobile device and a second photograph associated with the second mobile device; send a first notification to the first mobile device, the first notification comprising an indication that the first mobile device is in proximity to the second mobile device and a first request to send the first photograph to the second mobile device; send a second notification to the second mobile device, the notification comprising an indication that the second mobile device is in proximity to the first mobile device and a second request to send the second photograph to the first mobile device; upon approval of the first request send a third notification to the first mobile device of the relative distance from the first mobile device to the second mobile device along with the second photograph; and upon approval of the second request send a fourth notification to the second mobile device of the relative distance from the second mobile device to the first mobile device along with the first photograph.

According to another preferred embodiment, a method for zero-step proximity detection and private matchmaking using mobile device low emissions beacons is disclosed, comprising the steps of: emitting a beacon signal with short-range wireless communications; wherein the beacon signal comprises identifying information and application information associated with wireless network beacon, and a query for signal strength information; receiving a first response from a first mobile device reached by the emitted beacon signal, the first response comprising a first device identifier for the first mobile device, a first signal strength of the beacon signal as received by the first mobile device, and a second signal strength of a wireless connection with a second mobile device as received by the first mobile device; receiving a second response from a second mobile device reached by the emitted beacon signal, the second response comprising a second device identifier for the second mobile device, a third signal strength of the beacon signal as

received by the second mobile device, and a fourth signal strength of a wireless connection with the first mobile device as received by the second mobile device; calculating by triangulation relative distances between the wireless network beacon, the first mobile device, and the second mobile device using the first, second, third, and fourth signal strengths; sending the first device identifier and second device identifier to a remote computer server; receiving from the remote computer server a first photograph associated with the first mobile device and a second photograph associated with the second mobile device; sending a first notification to the first mobile device, the first notification comprising an indication that the first mobile device is in proximity to the second mobile device and a first request to send the first photograph to the second mobile device; sending a second notification to the second mobile device, the notification comprising an indication that the second mobile device is in proximity to the first mobile device and a second request to send the second photograph to the first mobile device; upon approval of the first request sending a third notification to the first mobile device of the relative distance from the first mobile device to the second mobile device along with the second photograph; and upon approval of the second request sending a fourth notification to the second mobile device of the relative distance from the second mobile device to the first mobile device along with the first photograph.

According to an aspect of an embodiment, the computer server is a remote business server comprising a second memory, a second processor, the database comprising customer information, and a second plurality of programming instructions stored in the second memory, and operating on the second processor, wherein the second plurality of programming instructions, when operating on the second processor, causes the remote business server to: receive the first device identifier and second device identifier; retrieve the first photograph associated with the person associated with the first mobile device from a database comprising customer information; retrieve the second photograph associated with the person associated with the second mobile device from the database comprising customer information; and send the first photograph and second photograph to the wireless network beacon.

According to an aspect of an embodiment, a database stored on the remote business server comprising customer information, the customer information comprising: a list of registered wireless mobile devices; a device identifier for each 100 registered wireless mobile device; and a photograph of a customer associated with each registered wireless mobile device.

According to an aspect of an embodiment, the first photograph, the second photograph, and the relative distances between the first mobile device and second mobile device are sent to a third mobile device operated by an employee of the business location.

According to an aspect of an embodiment, the wireless network beacon is part of a third mobile device operated by an employee of the business location.

According to an aspect of an embodiment, the wireless network beacon is part of a desk-affixed device for servicing customers at the business location.

According to an aspect of an embodiment, the wireless network beacon is a device affixed to a part of a building, wherein the wireless network beacon is configured to reach customers that may walk by a business establishment.

According to an aspect of an embodiment, the remote business server further comprises a point-of-sale system,

and wherein the database comprising customer information further includes information on past customer interactions and customer preferences, and wherein the wireless network beacon further communicates with the database comprising customer information to determine preferences or past sales information of the person associated with the first mobile device or the person associated with the second mobile device.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

The accompanying drawings illustrate several aspects and, together with the description, serve to explain the principles of the invention according to the aspects. It will be appreciated by one skilled in the art that the particular arrangements illustrated in the drawings are merely exemplary, and are not to be considered as limiting of the scope of the invention or the claims herein in any way.

FIG. 1 is a block diagram illustrating an exemplary system architecture for a zero-step authentication system.

FIG. 2 is a block diagram illustrating an exemplary architecture for an aspect of zero-step authentication system, the payment facilitation server.

FIG. 3 is a flow diagram illustrating an exemplary flow of payments in an embodiment.

FIG. 4 is a diagram illustrating an exemplary business/customer interaction and showing an exemplary screenshot.

FIG. 5 is a diagram illustrating an exemplary bill splitting feature and showing an exemplary screenshot.

FIG. 6 is a flow diagram showing the steps of an exemplary method for registration of a customer's mobile device and order placement.

FIG. 7 is a flow diagram showing the steps of an exemplary method for zero-step authentication and completion of a transaction.

FIG. 8 is a flow diagram showing the steps of an exemplary method for establishment of an account and pre-authorization of payments.

FIG. 9 is a flow diagram showing the steps of an exemplary method for bill splitting among customers.

FIG. 10 is a flow diagram showing the steps of an exemplary method for funds transfer among customers.

FIG. 11 is a block diagram illustrating an exemplary hardware architecture of a computing device.

FIG. 12 is a block diagram illustrating an exemplary logical architecture for a client device.

FIG. 13 is a block diagram showing an exemplary architectural arrangement of clients, servers, and external services.

FIG. 14 is another block diagram illustrating an exemplary hardware architecture of a computing device.

FIG. 15 is a system diagram illustrating a system for zero-step customer proximity detection using mobile device low emissions beacons.

FIG. 16 is a system diagram illustrating a system for zero-step customer proximity detection using mobile device low emissions beacons, with a biometric scanner for customer identification.

FIG. 17 is a system diagram illustrating two mobile devices with BTLE transmitters, receivers, and BTLE-enabled applications, measuring the distance between each other.

FIG. 18 is a system diagram illustrating multiple BTLE-enabled mobile devices measuring distances between each other, based on triangulations of position from overlapping distance values between each device.

FIG. 19 is a system diagram illustrating a user walking within range of a BTLE-enabled beacon device that may be a mobile device or an affixed beacon device, connected to a point-of-sale device and a business server over a network.

FIG. 20 is a method diagram illustrating a customer or patron walking into a business establishment, with employee devices acting as BTLE beacons and receivers to communicate with the customer or patron device.

FIG. 21 is a method diagram illustrating a customer or patron walking past a business establishment, with a BTLE beacon or beacons and receivers communicating with the customer or patron device, such as one affixed to a door entryway or near a window facing a sidewalk.

FIG. 22 is a method diagram illustrating a customer or patron walking up to a desk-mounted device such as one mounted in the front of a hotel or other business front-end, to assist or even take the place of a maitre'd and communicate with a customer mobile device.

FIG. 23 is a method diagram illustrating steps in the functionality of a BTLE proximity application.

FIG. 24 is a message flow diagram illustrating messages transferred between components in a system for zero-step customer proximity detection using mobile device low emissions beacons.

FIG. 25 is a system diagram illustrating a system for zero-step proximity detection and private matchmaking using mobile device low emissions beacons.

FIG. 26 is a flow diagram of an exemplary method for providing zero-step proximity detection and private matchmaking, according to an aspect of an embodiment.

DETAILED DESCRIPTION

The inventor has conceived, and reduced to practice, a system and methods for zero-step proximity detection and private matchmaking using mobile device low emissions beacons, which uses user mobile devices, a single or plurality of BLUETOOTH™ low-emissions (BTLE) beacons, a network, a server, and an application that may operate separately on a mobile device and the single or plurality of BLUETOOTH™ low-emissions (BTLE) beacons, which calculates the proximity between two or more users, which allows users to be alerted to other users in their proximity, and which provide a means for verifying and managing meetups between two or more users of the mobile devices.

Because the customer does not have to focus on his or her mobile device, the customer is free to interact naturally with the business environment and with employees of the business. For example, the customer is free to look around to experience the store's ambiance, which will tend to create a positive impression on the customer, and increase the likelihood that the customer will wish to return. Further, the customer is free to look at and speak with the business' employees, which facilitates personal interactions and relationships, making the customer feel more welcome and also increasing the likelihood that the customer will wish to return. These natural interactions are hindered by the handling and use of mobile phones, where the customer's attention is drawn away from the business environment and its employees in order to focus on the details of making or approving the transaction using his or her mobile device.

While the examples herein primarily discuss authorization of payments, the invention is not limited to authorization of monetary transactions, and can be used for authorization and transfer of any asset, or representation of an asset, that can be transferred electronically, for example: electronic transfers of real currency (credit card charges, bank transfers

and payments, etc.), transfers of blockchain-based currencies such as Bitcoin, and transfers of digitized contracts or promises to pay or transfer physical assets (including, but not limited to, IOUs, certificates of ownership of stocks or other securities, and deeds for real estate).

One or more different aspects may be described in the present application. Further, for one or more of the aspects described herein, numerous alternative arrangements may be described; it should be appreciated that these are presented for illustrative purposes only and are not limiting of the aspects contained herein or the claims presented herein in any way. One or more of the arrangements may be widely applicable to numerous aspects, as may be readily apparent from the disclosure. In general, arrangements are described in sufficient detail to enable those skilled in the art to practice one or more of the aspects, and it should be appreciated that other arrangements may be utilized and that structural, logical, software, electrical and other changes may be made without departing from the scope of the particular aspects. Particular features of one or more of the aspects described herein may be described with reference to one or more particular aspects or figures that form a part of the present disclosure, and in which are shown, by way of illustration, specific arrangements of one or more of the aspects. It should be appreciated, however, that such features are not limited to usage in the one or more particular aspects or figures with reference to which they are described. The present disclosure is neither a literal description of all arrangements of one or more of the aspects nor a listing of features of one or more of the aspects that must be present in all arrangements.

Headings of sections provided in this patent application and the title of this patent application are for convenience only, and are not to be taken as limiting the disclosure in any way.

Devices that are in communication with each other need not be in continuous communication with each other, unless expressly specified otherwise. In addition, devices that are in communication with each other may communicate directly or indirectly through one or more communication means or intermediaries, logical or physical.

A description of an aspect with several components in communication with each other does not imply that all such components are required. To the contrary, a variety of optional components may be described to illustrate a wide variety of possible aspects and in order to more fully illustrate one or more aspects. Similarly, although process steps, method steps, algorithms or the like may be described in a sequential order, such processes, methods and algorithms may generally be configured to work in alternate orders, unless specifically stated to the contrary. In other words, any sequence or order of steps that may be described in this patent application does not, in and of itself, indicate a requirement that the steps be performed in that order. The steps of described processes may be performed in any order practical. Further, some steps may be performed simultaneously despite being described or implied as occurring non-simultaneously (e.g., because one step is described after the other step). Moreover, the illustration of a process by its depiction in a drawing does not imply that the illustrated process is exclusive of other variations and modifications thereto, does not imply that the illustrated process or any of its steps are necessary to one or more of the aspects, and does not imply that the illustrated process is preferred. Also, steps are generally described once per aspect, but this does not mean they must occur once, or that they may only occur once each time a process, method, or algorithm is carried out

or executed. Some steps may be omitted in some aspects or some occurrences, or some steps may be executed more than once in a given aspect or occurrence.

When a single device or article is described herein, it will be readily apparent that more than one device or article may be used in place of a single device or article. Similarly, where more than one device or article is described herein, it will be readily apparent that a single device or article may be used in place of the more than one device or article.

The functionality or the features of a device may be alternatively embodied by one or more other devices that are not explicitly described as having such functionality or features. Thus, other aspects need not include the device itself.

Techniques and mechanisms described or referenced herein will sometimes be described in singular form for clarity. However, it should be appreciated that particular aspects may include multiple iterations of a technique or multiple instantiations of a mechanism unless noted otherwise. Process descriptions or blocks in figures should be understood as representing modules, segments, or portions of code which include one or more executable instructions for implementing specific logical functions or steps in the process. Alternate implementations are included within the scope of various aspects in which, for example, functions may be executed out of order from that shown or discussed, including substantially concurrently or in reverse order, depending on the functionality involved, as would be understood by those having ordinary skill in the art.

Definitions

“Business establishment” or “place of business” or “merchant” as used herein mean the location of any business entity with which customers may transact business. Typically, this will be a physical location where customers may enter the location and transact business directly with employees of the business, but may also be a business without a physical location such as an online or telephone order retailer. Many examples herein use a restaurant as the business establishment, but the invention is not limited to use in restaurants, and is applicable to any business establishment.

The term “network” as used herein means any communication connection between two or more computing devices, whether such connection is made directly (e.g., from one device containing a Bluetooth radio to another device containing a Bluetooth radio) or through an intermediary device such as a router, where a number of devices connected to the router may all communicate with one another.

Conceptual Architecture

FIG. 1 is a block diagram illustrating an exemplary system architecture **100** for a zero-step authentication system. The primary components of the system are a payment facilitation device **103**, a unified communications device or telephony exchange system (UC system) **101**, and a payment facilitation server **200**. Components or services that may connect to or be accessed by the system include wireless customer mobile devices **102**, and payment processors **109**. The payment facilitation device **103** is a computing device located at a business establishment that is connected (wired or wirelessly) to a UC system **101**. The payment facilitation device **103** may be wired, or wireless, or both, depending on the implementation of a given embodiment. While a payment facilitation device **103** and UC system **101** are specified in this embodiment, it is not required that they

be precisely in this configuration, and other configurations are possible, including a non-SIP computing device connected to a network without a US system **101**. The payment facilitation device **103** comprises a screen (not shown) and applications for a customer information entry portal **104** and a customer identification confirmation application **105**. The payment facilitation device **103** may be a mobile computing device like a mobile phone or tablet computer or may be a desktop or tabletop computing device.

The customer information entry portal **104** is an application on the payment facilitation device **103** that allows an employee of the business to enter customer details such as name, telephone number, device identifier, bank, debit, or credit card details, payment preferences, and, if necessary, customer account refill limits and customer account refill amounts. The device identifier may be any information that allows the system to identify the customer mobile device **102**, including, but not limited to, a mobile access control (MAC) address (e.g., a MAC address for the device’s WiFi radio, a MAC address for the device’s Bluetooth radio, etc.), the device’s **102** serial number, the device’s mobile equipment identifier (MEID) or international mobile equipment identity (IMEI) number, the integrated circuit card identifier (ICCID) of the subscriber identity module (SIM) card inserted into the customer mobile device **102**, and the device’s **102** secure element identification (SEID) number.

The customer identification and confirmation application **105** is an application that provides security in financial transactions by allowing the employee of the business to visually confirm the identity of the customer making a transaction. For example, the payment facilitation device at a particular business location may be connected to multiple customer devices simultaneously. The customer identification and confirmation application **105** may display a photo of the user (customer) of each such connected customer device, and the employee may select the device of the customer making the transaction by clicking on the customer’s photo as displayed by the customer identification and confirmation application **105** on the payment facilitation device **103**.

The UC system **101** is a device or service (e.g., online service) that integrates different methods of communication (e.g., phone calls, video calls, short message service (SMS), instant messaging (chat), email) and allows for all of those different methods of communication to be accessed through a computing device such as a mobile phone or tablet computer. A UC system **101** is the modern, and much more flexible and powerful, form of a private branch exchange (PBX) telephone equipment system that allowed businesses to connect multiple internal telephones to a single incoming telephone line. In this example, the UC system **101** acts as the interface between the payment facilitation device **103**, the customer mobile devices **102**, and the payment facilitation server **200**.

A customer mobile device **102** may be connected to the system via any wireless network connection, for example through the Internet **106**, a mobile (cellular) network **107**, or through a local wireless network **108** such as WiFi, Bluetooth, etc. In the case of remote connections such as those made through the Internet **106** or mobile service **107**, the location of a customer mobile device **102** and its location relative to the payment facilitation device **103** or other customer mobile devices **102** may be established through use of the device’s satellite positioning system hardware (e.g., GPS, GLONASS, Galileo), by identifying the location of an intermediary device to which the device is connected (e.g., a WiFi router, etc. In the case of local connections,

which typically use short range wireless transmissions, it may not be necessary to determine the location of the mobile customer device **102** because the short range of wireless communications establishes that the payment facilitation device **103** or other mobile customer devices are nearby. For example, when using a Bluetooth Class **2** connection to connect to other devices, it will be apparent that the other devices are nearby because Bluetooth Class **2** has an effective range on the order of 10 meters.

In a typical scenario, the first time a customer enters a business establishment with a customer mobile device **102**, an employee of the business establishment will enter the customer's information using the customer information entry portal **104** and register the customer mobile device **102** using the customer mobile device's **102** identification. When a customer mobile device **102** enters a business establishment, the payment facilitation device **103** and customer mobile device **102** will automatically detect each other and establish a network connection. The payment facilitation device **103** will recognize the customer mobile device **102** using the customer mobile device's identifier. As the customer makes an order, the business's employee will confirm the identity of the customer using the customer identification confirmation application **105**. The payment facilitation device connects to the payment facilitation server **200**, either directly or through the UC system **101**, forwards the customer information and order information to the payment facilitation server **200**. The payment facilitation server **200**, checks the customer's account and either deducts and appropriate amount from the customer's prepaid account or sends the payment details to a payment processor **109** for processing. Once the payment is processed, the payment facilitation server **200** sends a confirmation of the payment either to the payment facilitation device **103**, the customer mobile device **102**, or both. In a scenario where the customer is in a remote location from the business establishment (e.g., a phone order or online order), the process is much the same except that the first time customer information entry and mobile device registration occurs remotely, and the employee does not visually identify the customer (although other methods of identifying the customer may apply, such as personal identification number (PIN) codes, voice print identification, telephone number identification, or customer mobile device **102** identifiers).

FIG. **2** is a block diagram illustrating an exemplary architecture for an aspect of zero-step authentication system, the payment facilitation server **200**. The payment facilitation server **200** manages customer information and payments from multiple customers. In this example, the payment facilitation server comprises a customer information database **201**, a customer identification engine **202**, a payment processing manager **209**, and one or more applications for managing bill splitting, fund transfers, and account information. Note that, in some embodiments, the bill splitting and fund transfer applications may be applications on the customer mobile device **102** instead of on the payment facilitation server **200**. As the payment facilitation server receives customer information and device registrations, it stores them in a customer information database. Such customer information may comprise customer details such as name, telephone number, device identifier, bank, debit, or credit card details, payment preferences, and, if necessary, customer account refill limits and customer account refill amounts. The device identifier may be any information that allows the system to identify the customer mobile device **102**, including, but not limited to, a mobile access control (MAC) address (e.g., a MAC address for the device's WiFi

radio, a MAC address for the device's Bluetooth radio, etc.), the device's **102** serial number, the device's mobile equipment identifier (MEID) or international mobile equipment identity (IMEI) number, the integrated circuit card identifier (ICCID) of the subscriber identity module (SIM) card inserted into the customer mobile device **102**, and the device's **102** secure element identification (SEID) number.

The customer identification engine **202** provides additional security by confirming the identity of the customer before processing payments. In this example, the customer identification engine **202** has three separate identification methods, a voiceprint identifier **203**, a telephone number identifier **204**, and a device ID identifier **205**. The voiceprint identifier **203** can provide confirmations of customer identities either by matching voice samples of specific words and phrases provided by the customer as during account creation and device registration or, in a more sophisticated version, may match the customer's voice to any spoken words and phrases using machine learning algorithms. The telephone number identifier **204** receives caller identification (caller ID) information from the UC system **101**, and verifies that the phone number from which the order is being made matches the phone number in the customer account information. The device ID identifier **205** receives a device identifier from the UC system **101** and matches it to the device identifier in the customer database **201** to confirm that the device is registered. In some embodiments, other methods of identifying the customer may be used, for example, PIN codes. In some embodiments, two or more of these identifiers may be used together to confirm the customer's identity.

As customer information and order information is received, the payment facilitation server **200** checks the customer's account using the customer account management application **208** and either deducts and appropriate amount from the customer's prepaid account or sends the payment details to the payment processing manager **209**, which forwards the payment request to a payment processor **109** for processing. Once the payment is processed, the payment facilitation server **200** sends a confirmation of the payment either to the payment facilitation device **103**, the customer mobile device **102**, or both.

The bill splitting application **206** receives a bill that is to be shared by two or more customers (e.g., a restaurant dining bill), the device identifier of two or more customer mobile devices **102**, and provides an interface for those customers to allocate items on the bill between the customers. Once each of the customers involved approves the allocation, the bill splitting application forwards each customer's portion of the bill to the payment processing manager **209**. The fund transfer application **207** operates in a similar manner for fund transfers between customers. Customers involved in the fund transfer specify amounts to be transferred to other customers, and once approved by all customers involved in the fund transfer, the fund transfer application forwards the approved funds transfers to the payment processing manager **209** for execution.

FIG. **3** is a flow diagram illustrating an exemplary flow of payments **300** in an embodiment. When a customer **303** authorizes a transaction (which authorization may be pre-approved) through his or her customer mobile device **102**, the payment authorization is sent to the business **302** at the business' payment facilitation device **103**. The payment facilitation device **103** of the business **302** sends a payment request to the payment facilitation server **200**. The payment facilitation server **200** checks the customer's pre-paid account **304** to determine whether pre-paid funds are avail-

able. If such funds are available, a deduction is made from the customer pre-paid account **304** in the amount of the authorized payment, and a confirmation is confirmed by the payment facilitation server **200**. If sufficient funds are not available in the customer pre-paid account, the account is either refilled or a direct payment request is made. In either such case, the payment facilitation server **200** sends a payment request to a payment processor **109**, which are financial intermediaries like Visa and Mastercard, who process transactions on behalf of financial institutions **301** (i.e., banks). The payment processor **109** sends the payment request to a financial institution **301** at which the customer **303** has an account. The financial institution **301** receives the payment request, and sends a payment to the payment processor **109**, typically along with a transaction fee. The payment processor **109** receives the payment and transaction fee, and forwards the payment to the payment facilitation server along with a portion of the transaction fee. The payment facilitation server **200** forwards the payment to the business **302**, which forwards a confirmation of payment **303** to the customer, completing the transaction.

FIG. **25** is a system diagram illustrating a system for zero-step proximity detection and private matchmaking using mobile device low emissions beacons. A beacon device **2501** exists, such as a smartphone, PDA, tablet, or other device, which may run an operating system including IOS™, WINDOWS MOBILE™, ANDROID™, and potentially others, and which may be in the possession of a customer or business client. The beacon device **2501** is connected to, or has built into it, a BLUETOOTH™ Low Emissions (“BTLE”) transmitter and receiver **2502**, and an application that is configured to utilize such a transmitter/receiver **2503**. Such an application may be written in a variety of programming languages, such as C, C++, C#, JAVA™, or others. The application may be written in a general-purpose manner to interact with any business BTLE beacon or mobile device acting as a beacon, such as a plurality of user mobile devices operated by a business or customer of the business **2505**, and may either maintain a local memory store of recognized and known businesses (which may be treated differently than unknown business beacons) or may connect to a network **2510** and server **2520** to determine if a business’ supplied information over BTLE transmitter and receiver communications is legitimate. User mobile devices **2505** may represent a plurality of devices such as smartphones, PDAs, tablets, or other devices, which do not necessarily need to be all of one device type, which may run operating systems including IOS™, WINDOWS MOBILE™ ANDROID™, and potentially others, each of which possesses a BTLE transmitter and receiver **2506** and an application configured to utilize the BTLE transmitter/receiver **1507**. The business-side application may be the same application as the one operating on the beacon device or devices **2503**, merely configured differently, or it may be a separate application that merely is capable of interacting with the client-side application **2503**. A beacon device application **2503** is capable of communicating with a network **2510** over either a BTLE transmitter/receiver **2502**, or over another form of transmitter/receiver such as WIFI™ or cellular data, to communicate with a network-connected server **2520** and a point-of-sale (“POS”) system **2541**. The purpose of the business-side application’s **2503** communications with the server **2520** and POS **2541** are to both manage and interact with the business’ items for sale and their inventory management, if any, and to interact with a server **2520** hosting a customer database **2530** for the purposes of identifying, retrieving, and saving customer

information to provide personalized interactions with customer or user-side applications **2507**. Such a system may also be used for zero-step authentication, for returning or known customers or clients. Such communications may occur over a local area network, the internet, or some other wide area network, and the server **2520** and customer database **2530** may be hosted either locally or remotely, or exist in a cloud infrastructure. A mobile device **2505** with the client application **2507** may communicate over a network **2510** or directly with a beacon device or devices **2501** and the business-side application **2503** to establish an initial point of contact, identify a customer if possible, calculate their proximity based on the energy levels of the signal transmissions to and from the user and business device or devices, and with a plurality of devices with different positioning sharing their proximity data, it is possible to calculate a user’s location relative to the devices within or near a business, for purposes such as enforcing social distancing, managing table assignments in a restaurant, ensuring that there is an even distribution of employees on a business floor relative to customer positions and routing, and even apply machine learning to customer routes through a business to determine what paths customers may seem to take such as in retail outlets, to maximize their revenue potential by placing products in a manner along the route designed to entice customers more effectively to purchase them.

According to an embodiment, system **2500** may be configured to provide zero-step proximity detection and private matchmaking by utilizing beacons **2501** and photograph-based authorization for personal meetings. In such a configuration, system **2500** can use beacons **2501** and user device signals to determine the proximity of two or more system users in relation to each other. After a determination of proximity is made, a message manager **2504**, **2508** may be configured to notify user A of proximity to user B (or to more than one other user). Server **2520** may provide a photograph of user A to user B, only if user A grants permission to share a photograph of themselves. If both user A and user B agree to a request to exchange information, server **2520** can provide to each user photographs and location/proximity information to facilitate a meet-up.

According to some embodiments, server **2520** may receive, from a wireless network beacon, both a first device identifier associated with a first user (e.g., user A) and a second device identifier associated with a second user (e.g., user B), and then use the device identifiers to locate and retrieve information and/or photographs associated with the users from customer database **2530**. Once server **2520** has successfully retrieved the users’ information and photographs, that data may be sent to a message manager **2504**, **2508** operating as part of BTLE applications **2503**, **2507**. Message manager **2504**, **2508** may generate a notification to one of the users that they are within proximity of another user of the zero-step private matchmaking. Upon receiving such a notification, a user may approve the system **2500** to provide a photograph to the other user in close proximity along with a message such as, for example, “User A is near you and is interested in a meetup”. Upon reception of the proximity notification and photograph of the other user, a second user may agree and then message manager may provide photographs and location/proximity information to facilitate a meetup between the two users.

According to some embodiments, the system **2500** may be configured to provide enhanced, zero-step customer location determination and confirmation using a plurality of mobile devices **2505** and a plurality of beacon devices **2501**,

each of which is configured to transmit and receive BTLE signals and further configured to determine a location of an individual (e.g., customer, mobile device user, employee, etc.) by using signals processing and various sensor data gathered via the sensors/hardware **2509** within the mobile devices. The system may combine the beacon functionality with on-device sensors to provide zero-step user (e.g., customer, employee, etc.) location determination. Server **2520** may be configured to receive, retrieve, or otherwise obtain data such as, for example, global positioning system (GPS) data associated with a mobile device of a customer, from which an initial, rough estimate of the customer location may be determined, and then server **2520** can check for known beacons **2501**, **2505** in an approximate area defined, at least in part, by the GPS data in order to refine the location determination. Additionally, hardware and/or sensors **2509** (e.g., motion, barometer, compass, magnetometer, geomagnetic field sensor, accelerometer, proximity sensor, gyroscope, pressure sensors, camera, microphone, LiDAR, *Soli* sensor, etc.) embedded in the mobile device **2505** may be used in conjunction with the beacons **2501** to further refine and to provide a more precise location determination of the mobile device user. For example, server **2520** may receive, retrieve, or otherwise obtain geomagnetic field sensor and accelerometer data to determine a mobile device's position relative to the magnetic north pole. Often-times geomagnetic field sensor and accelerometer data is in the form of multi-dimensional arrays of sensor values such as, for example, a geomagnetic field sensor may provide geomagnetic field strength values for each of the three coordinate axes during a single sensor event (i.e., sensor measurement).

According to some embodiments, the system **2500** may be used to provide zero-step location confirmation. For example, the system may be used to confirm if a customer or employee is in the correct location (e.g., in proximity to a restaurant or some other place of business, at certain stations within a restaurant [at the grill, at the check-in desk, at the fryer station, etc.], etc.). In such an embodiment, beacons **2501** and/or user mobile devices **2505** may be utilized to determine a position of an individual, and then correlate that position with a desired position within a merchant **2540** or other business establishment. For example, in a restaurant setting reference beacons **2543** may be placed at specific stations **2542** where their location and position within the restaurant is known and unchanging. The use of such reference beacons **2543** may be used in conjunction with other beacons **2501** located in the restaurant, a user mobile device **2505** functioning as a beacon, and with various hardware/sensors **2509** operating on the user mobile device in order to confirm a precise location of an employee or a customer. In some embodiments, a triangulation may be computed using the known locations of the reference beacons **2543** to determine the position/location of the user mobile device with respect to the actual position of the reference beacons **2543** and/or various stations **2542** existing within the merchant **2540** business establishment. The triangulation of the reference beacons may be computed at server **2520** which can request a response from the reference beacons and then use the response data to compute a triangulation. In some embodiments, the response may comprise a reference beacon device identifier, a signal strength of the beacon signal, and a signal strength of a wireless connection with a user mobile device. According to other embodiments, the triangulation of the reference beacons **2543** may be computed at one of the reference beacons

and/or another beacon device **2501**, **2505** which can request a response from the reference beacons.

According to various embodiments, server **2540** or a beacon **2501**, **2505** component such as message manager **2504**, **2508** may be configured to notify a customer or employee if they are in the wrong spot, or if they have been in the wrong spot for too long. Such notifications may be sent to a mobile device associated with the customer or employee via network **2510**. In some embodiments, the notification may comprise a text-based message such as, for example, an SMS message via a text message application or some other messaging service stored and operating on a user mobile device **2505**. In some embodiments, notifications may comprise information and/or instructions to the customer or employee which can help guide them to a desired location. In this way, a system **2500** user may passively receive corrections without needing to use a dedicated navigation application, or the like, stored and operating on their mobile device.

DETAILED DESCRIPTION OF EXEMPLARY ASPECTS

FIG. 4 is a diagram illustrating an exemplary business/customer interaction **400** and showing an exemplary screenshot. In this example, a customer **401** (who already has an account and registered device **402** at a business establishment) makes an order. The customer's device **402** and the payment facilitation device **103** detect each other and establish a connection when the customer **401** enters the business establishment. The customer's photograph **403** is displayed on the business' payment facilitation device **103**, along with the customer's information **404** and order details **405**. An employee of the business clicks on the customer photograph **403** to confirm the identity of the customer **401**. Once confirmed, the customer device **402** automatically approves payment and receives confirmation of the payment without the customer having to handle the device **402**. The customer device **402** may remain in the customer's pocket, purse, backpack, etc., and does not have to be removed to complete the transaction.

FIG. 5 is a diagram illustrating an exemplary bill splitting feature **500** and showing an exemplary screenshot. In this example, three customers, Bob **501**, Sally **503**, and Joe **505**, each with their respective mobile devices **502**, **504**, and **506**, have a meal together at a restaurant and want to split the bill among themselves. Each customer's mobile device has a bill splitting application installed on it, which shows a copy of the bill and the customers who dined together. For example, Bob's **501** mobile device **502** shows the bill information **507** for the group on the left-hand side of his screen, and a window for himself **508**, a window for Sally **509**, and window for Joe **510** on the right side. The mobile devices **504**, **506** of Sally **503** and Joe **505** show similar screens. The windows **508**, **509**, **510**, each show a photo (or other representation) of the customer, a space for allocating items from the bill, and a total of the items allocated to that customer. As each customer, on his or her respective mobile device **502**, **504**, **506**, allocates food and drink items from the bill information **507** by clicking on them and dragging them to the window of a person on the right, the allocation of those food and drink items appears in the window of the person to whom the item has been allocated, as indicated by the arrows. For example, the risotto Milanese and white wine have been allocated to Bob (either by Bob or by one of the other two customers), a total due from Bob of \$26 is shown, and this information is updated on all three mobile

devices **502**, **504**, **506**. Once all three customers **501**, **503**, **505** approve the allocation, each person's mobile device **502**, **504**, **506** processes the payment for the amount allocated to that customer. In some embodiments, unallocated items may be automatically split among the customers in the group.

FIG. **6** is a flow diagram showing the steps of an exemplary method for registration of a customer's mobile device and order placement. When a customer calls restaurant a first time to place an order **601**, the customer's telephone number is captured using UC telephony equipment, and additional customer information is gathered and entered into database by an employee of the business **602**. The customer then makes his or her order and the order is completed **603**. Each time the customer makes a subsequent call to same business to place an order **604**, the customer's telephone number is captured using UC telephone equipment, and the customer's information is retrieved from a customer database using a customer identification application **605**. The customer then makes his or her order and the order is completed **606** without the customer having to provide his or her information. The same procedure is used when a customer physically enters a business establishment, except that the registration is performed in person.

FIG. **7** is a flow diagram showing the steps of an exemplary method for zero-step authentication and completion of a transaction. When a customer enters a business establishment **701**, the customer's wireless device and business payment facilitation device detect each other and automatically establish connection **702**. The business payment facilitation device retrieves the customer device identifier (ID) and uses the customer device ID to retrieve customer information from customer information database located on a payment facilitation server **703**. The business payment facilitation device displays customer's photo and information to a restaurant employee, who confirms customer's identity by clicking on the photo of the customer **704**. The customer then places an order **705**. When the order is placed, the business payment facilitation devices ends payment details to payment facilitation server, which either deducts amount from customer's pre-paid account balance or sends charge to payment processors **706**. Optionally, an additional security step may be inserted wherein the customer's wireless device receives and displays a request for confirmation of the order from the business CIP device and the customer clicks on the displayed request to confirm the order **707**. Finally, the customer's order is completed **708**.

FIG. **8** is a flow diagram showing the steps of an exemplary method for establishment of an account and pre-authorization of payments. First, a customer establishes and account using his or her customer mobile device and provides payment details (e.g., credit card, debit card, bank details for ACH, etc.) **801**. The customer then sets automatic an account payment limit, a refill limit, and a refill amount **802**. For example, the customer may set a payment limit for each transaction at \$50, a refill limit (i.e., minimum account balance below which the account will be automatically refilled) of \$10, and a refill amount of \$100. The customer may choose to have such payments sent automatically without handling his or her mobile device (zero-step authentication) **803** or may choose to authorize each payment individually using his or her mobile device **804**. A customer account management application funds the account in the amount of the refill amount using payment details **805**. Thus, in this example, the customer has pre-authorized payments of up to \$50 per transaction, and pre-authorized the system to automatically refill his account from the customer's

financial institution (or credit card) in the amount of \$100 whenever the account balance falls below \$10. When the customer places an order, the customer account management application checks account balance, deducts an amount equal to the order for the order (after confirmation, if required), and refills account balance using payment information if the account balance falls below the refill limit **806**.

FIG. **9** is a flow diagram showing the steps of an exemplary method for bill splitting among customers. Each customer mobile device runs an application that shows nearby customer devices also using the payment system **901**. Customers dining together form a group by selecting one another (or accepting a group formation created by one or more of them) **902**. Each customer's device displays a copy of the itemized bill on one side of the screen, and a photo (or other representational image) of each other customer in the group on the other side of the screen **903**. One or more of the customers in the group assigns payment by clicking and dragging items from the itemized bill to the photo (or image) of the customer responsible for paying for that item **904**. When the group is finished assigning payments, each customer approves his/her proposed payment assignments, with unassigned items being distributed equally among the customers in the group **905**. After all customers in the group have approved their payment assignments, the payment system processes payments from each customer's account according to the approved payment assignments **906**.

FIG. **10** is a flow diagram showing the steps of an exemplary method for funds transfer among customers. Each customer mobile device runs an application that shows nearby customer devices also using the payment system **1001**. Customers wishing to exchange funds form a group by selecting one another (or accepting a group formation created by one or more of them) **1002**. Each customer's device displays a photo (or other representational image) of each other customer in the group **1003**. One or more of the customers in the group proposes a fund transfer by clicking and dragging from one customer to another, creating an arrow between that pair of customers in the group indicating a direction of transfer, and enters an amount of funds to be transferred **1004**. When the group is finished proposing fund transfers, each customer approves his/her proposed fund transfer(s) **1005**. After all customers in the group have approved their proposed transfers, the payment system processes payments from each customer's account according to the approved fund transfers **1006**.

FIG. **15** is a system diagram illustrating a system for zero-step customer proximity detection using mobile device low emissions beacons. A mobile device **1501** exists, such as a smartphone, PDA, tablet, or other device, which may run an operating system including IOS™, WINDOWS MOBILE™, ANDROID™, and potentially others, and which may be in the possession of a customer or business client. The mobile device **1501** is connected to, or has built into it, a BLUETOOTH™ Low Emissions ("BTLE") transmitter and receiver **1502**, and an application that is configured to utilize such a transmitter/receiver **1503**. Such an application may be written in a variety of programming languages, such as C, C++, C#, JAVA™, or others. The application may be written in a general-purpose manner to interact with any business BTLE beacon or mobile device acting as a beacon, such as a plurality of mobile devices operated by a business **1505**, and may either maintain a local memory store of recognized and known businesses (which may be treated differently than unknown business beacons) or may connect to a network **1510** and server **1520** to determine of a business' supplied information over BTLE

transmitter and receiver communications is legitimate. Business mobile devices **1505** may represent a plurality of devices such as smartphones, PDAs, tablets, or other devices, which do not necessarily need to be all of one device type, which may run operating systems including IOS™, WINDOWS MOBILE™, ANDROID™, and potentially others, each of which possesses a BTLE transmitter and receiver **1506** and a business-side application configured to utilize the BTLE transmitter/receiver **1507**. The business-side application may be the same application as the one operating on the client or customer device or devices **1503**, merely configured differently, or it may be a separate application that merely is capable of interacting with the client-side application **1503**. A business-side application **1507** is capable of communicating with a network **1510** over either a BTLE transmitter/receiver **1506**, or over another form of transmitter/receiver such as WIFI™ or cellular data, to communicate with a network-connected server **1520** and a point-of-sale (“POS”) system **1540**. The purpose of the business-side application’s **1507** communications with the server **1520** and POS **1540** are to both manage and interact with the business’ items for sale and their inventory management, if any, and to interact with a server **1520** hosting a customer database **1530** for the purposes of identifying, retrieving, and saving customer information to provide personalized interactions with customer or client-side applications **1503**. Such a system may also be used for zero-step authentication, for returning or known customers or clients. Such communications may occur over a local area network, the internet, or some other wide area network, and the server **1520** and customer database **1530** may be hosted either locally or remotely, or exist in a cloud infrastructure. A mobile device **1501** with the client application **1503** may communicate over a network **1510** or directly with a business device or devices **1505** and the business-side application **1507** to establish an initial point of contact, identify a customer if possible, calculate their proximity based on the energy levels of the signal transmissions to and from the user and business device or devices, and with a plurality of devices with different positioning sharing their proximity data, it is possible to calculate a user’s location relative to the devices within or near a business, for purposes such as enforcing social distancing, managing table assignments in a restaurant, ensuring that there is an even distribution of employees on a business floor relative to customer positions and routing, and even apply machine learning to customer routes through a business to determine what paths customers may seem to take such as in retail outlets, to maximize their revenue potential by placing products in a manner along the route designed to entice customers more effectively to purchase them.

FIG. 16 is a system diagram illustrating a system for zero-step customer proximity detection using mobile device low emissions beacons, with a biometric scanner for customer identification. A mobile device **1501** exists, such as a smartphone, PDA, tablet, or other device, which may run an operating system including IOS™, WINDOWS MOBILE™, ANDROID™ and potentially others, and which may be in the possession of a customer or business client. The mobile device **1501** is connected to, or has built into it, a BLUETOOTH™ Low Emissions (“BTLE”) transmitter and receiver **1502**, and an application that is configured to utilize such a transmitter/receiver **1503**. Such an application may be written in a variety of programming languages, such as C, C++, C#, JAVA™, or others. The application may be written in a general-purpose manner to interact with any business BTLE beacon or mobile device

acting as a beacon, such as a plurality of mobile devices operated by a business **1505**, and may either maintain a local memory store of recognized and known businesses (which may be treated differently than unknown business beacons) or may connect to a network **1510** and server **1520** to determine of a business’ supplied information over BTLE transmitter and receiver communications is legitimate. Business mobile devices **1505** may represent a plurality of devices such as smartphones, PDAs, tablets, or other devices, which do not necessarily need to all of one device type, which may run operating systems including IOS™, WINDOWS MOBILE™ ANDROID™, and potentially others, each of which possesses a BTLE transmitter and receiver **1506** and a business-side application configured to utilize the BTLE transmitter/receiver **1507**. The business-side application may be the same application as the one operating on the client or customer device or devices **1503**, merely configured differently, or it may be a separate application that merely is capable of interacting with the client-side application **1503**. A business-side application **1507** is capable of communicating with a network **1510** over either a BTLE transmitter/receiver **1506**, or over another form of transmitter/receiver such as WIFI™ or cellular data, to communicate with a network-connected server **1520** and a point-of-sale (“POS”) system **1540**. The purpose of the business-side application’s **1507** communications with the server **1520** and POS **1540** are to both manage and interact with the business’ items for sale and their inventory management, if any, and to interact with a server **1520** hosting a customer database **1530** for the purposes of identifying, retrieving, and saving customer information to provide personalized interactions with customer or client-side applications **1503**. Such a system may also be used for zero-step authentication, for returning or known customers or clients. Such communications may occur over a local area network, the internet, or some other wide area network, and the server **1520** and customer database **1530** may be hosted either locally or remotely, or exist in a cloud infrastructure. A mobile device **1501** with the client application **1503** may communicate over a network **1510** or directly with a business device or devices **1505** and the business-side application **1507** to establish an initial point of contact, identify a customer if possible, calculate their proximity based on the energy levels of the signal transmissions to and from the user and business device or devices, and with a plurality of devices with different positioning sharing their proximity data, it is possible to calculate a user’s location relative to the devices within or near a business, for purposes such as enforcing social distancing, managing table assignments in a restaurant, ensuring that there is an even distribution of employees on a business floor relative to customer positions and routing, and even apply machine learning to customer routes through a business to determine what paths customers may seem to take such as in retail outlets, to maximize their revenue potential by placing products in a manner along the route designed to entice customers more effectively to purchase them.

According to an embodiment, a customer **1610** may walk near or into a business establishment that operates a biometric scanner **1620**, which may be any one of, or a combination of, a fingerprint scanner, iris scanner, facial recognition scanner, voice scanner, or other biometric scanner to identify individuals, for either one-step or zero-step authentication, supplementing or replacing the authentication steps taken by a customer’s application **1503**.

FIG. 17 is a system diagram illustrating two mobile devices with BTLE transmitters, receivers, and BTLE-en-

abled applications, measuring the distance between each other. Two mobile devices **1711**, **1721** exist, such as smartphones, PDAs, tablets, or other devices, which may run an operating system including IOS™, WINDOWS MOBILE™, ANDROID™, and potentially others, and which may be in the possession of a customer or business client, and a business employee or be affixed to a part of a business such as a desk. Each mobile device **1711**, **1721** is connected to, or has built into it, a BLUETOOTH™ Low Emissions (“BTLE”) transmitter and receiver **1712**, **1722**, and an application that is configured to utilize such a transmitter/receiver **1713**, **1723**. Such an application may be written in a variety of programming languages, such as C, C++, C#, JAVA™, or others. The application may be written in a general-purpose manner to interact with any business or customer BTLE beacon or mobile device acting as a beacon, such as a plurality of mobile devices operated by a business. Business mobile devices may represent a plurality of devices such as smartphones, PDAs, tablets, or other devices, which do not necessarily need to all of one device type, which may run operating systems including IOS™, WINDOWS MOBILE™, ANDROID™, and potentially others, each of which possesses a BTLE transmitter and receiver **1712**, **1722** and an application configured to utilize the BTLE transmitter/receiver **1713**, **1723**. Each device has an operating range **1710**, **1720** for their BTLE transmitter/receiver to operate, and when a device crosses into this threshold, it may receive a beacon transmission from another device, and they may transmit communications with each other. The strength of the signal and other signal characteristics may be measured to determine a rough approximation of the distance between the devices.

FIG. **18** is a system diagram illustrating multiple BTLE-enabled mobile devices measuring distances between each other, based on triangulations of position from overlapping distance values between each device.

A plurality of mobile devices **1810**, **1820**, **1830**, **1840** exist, such as smartphones, PDAs, tablets, or other devices, which may run an operating system including IOS™, WINDOWS MOBILE™, ANDROID™, and potentially others. Each mobile device **1810**, **1820**, **1830**, **1840** is connected to, or has built into it, a BLUETOOTH™ Low Emissions (“BTLE”) transmitter and receiver, and an application that is configured to utilize such a transmitter/receiver. Each device has an operating range for their BTLE transmitter/receiver to operate, and when a device crosses into this threshold, it may receive a beacon transmission from another device, and they may transmit communications with each other. The strength of the signal and other signal characteristics may be measured to determine a rough approximation of the distance between the devices.

Using a plurality of devices each with other devices in range of each other, but with different detected distances between them, as shown, triangulation of a target device may be possible, such as through the use of multiple overlapping distance circles centered on each device, similar to the method by which the epicenter of earthquakes may be detected by multiple detection stations at different points, by calculating how far away the epicenter was from each of the stations, in which case, with 3 or more stations, only one possible point could be the center.

FIG. **19** is a system diagram illustrating a user walking within range of a BTLE-enabled beacon device that may be a mobile device or an affixed beacon device, connected to a point-of-sale device and a business server over a network. A customer **1910** with a mobile device exists and walks within range of a BTLE beacon **1930**, in which the customer mobile

device and beacon may both or either be a smartphone, PDA, tablet, or other device, which may run an operating system including IOS™, WINDOWS MOBILE™, ANDROID™, and potentially others, and which may be in the possession of a customer or business client. The mobile device and beacon both are connected to, or have built into themselves, a BTLE transmitter and receiver **1931**, and an application that is configured to utilize such a transmitter/receiver **1932**. Such an application may be written in a variety of programming languages, such as C, C++, C#, JAVA™, or others. The application may be written in a general-purpose manner to interact with any business BTLE beacon or mobile device acting as a beacon, and may be capable of communicating with a network **1920** over either a BTLE transmitter/receiver **1931**, or over another form of transmitter/receiver such as WIFI™ or cellular data, to communicate with a network-connected server **1940** and a point-of-sale (“POS”) system **1960**. The purpose of the business-side application’s **1932** communications with the server **1940** and POS **1960** are to both manage and interact with the business’ items for sale and their inventory management, if any, and to interact with a server **1940** hosting a customer database **1950** for the purposes of identifying, retrieving, and saving customer information to provide personalized interactions with customer or client-side applications. Such a system may also be used for zero-step authentication, for returning or known customers or clients. Such communications may occur over a local area network, the internet, or some other wide area network, and the server **1940** and customer database **1950** may be hosted either locally or remotely, or exist in a cloud infrastructure. A mobile device with the client application may communicate over a network **1920** or directly with a business beacon **1930** and the business-side application **1932** to establish an initial point of contact, identify a customer if possible, calculate their proximity based on the energy levels of the signal transmissions to and from the user and business device or devices, and with a plurality of devices with different positioning sharing their proximity data, it is possible to calculate a user’s location relative to the devices within or near a business, for purposes such as enforcing social distancing, managing table assignments in a restaurant, ensuring that there is an even distribution of employees on a business floor relative to customer positions and routing, and even apply machine learning to customer routes through a business to determine what paths customers may seem to take such as in retail outlets, to maximize their revenue potential by placing products in a manner along the route designed to entice customers more effectively to purchase them.

According to the embodiment, a customer may walk past a business with a beacon **1930** affixed near the area where the customer may be walking, in order to detect the customer and potentially provide incentives via their mobile device to enter the business. Other uses for such a system may be apparent such as analytics for recognized customers that walk past the business at certain hours or in relation to certain changes in the business.

FIG. **20** is a method diagram illustrating a customer or patron walking into a business establishment, with employee devices acting as BTLE beacons and receivers to communicate with the customer or patron device. A customer first may walk into a business establishment **2010**, such as a restaurant, retail outlet, hotel, or other business, before a business-operated BTLE beacon pings customer mobile device with business info **2020**. Such a BTLE beacon may be a mounted or affixed device such as built into the ceiling,

built into a wall or walls, affixed to a desk, or it may be a mobile device with a BTLE transmitter and receiver and the associated application for driving the transmitter/receiver. The customer mobile device application may respond to the beacon ping with identifying info if the beacon is properly credentialed **2030**, from the customer's own BTLE transmitter/receiver. Proper business beacon credentials may be something stored locally on the customer mobile device, or it may be stored on a server or cloud service that the application may communicate with over a network such as the Internet, and may be a defined set of credentials or a hash key that is defined by the application or application provider. The business BTLE beacon may forward any received customer info to a server or servers, or cloud service, to identify the customer, if they are a repeat-customer and known to the service **2040**. A brand-new customer who has never used the application before, or who has not used the application with this business before, may not be able to be identified, but as a new customer their identity within the application may be saved such as a hash of their username or other identifying information in compliance with local regulations and laws surrounding personal information, and their preferences and habits in the business may be saved as well throughout their interaction in the business. If they are identified, the business BTLE beacon or beacons may forward information such as menu data for no-contact ordering, table assignment, reservation information for a hotel, or other business information that may be of interest to the customer, to the customer mobile device **2050**, while the customer proximity to other customers, to employees, and to certain parts of the business may be monitored with a plurality of business BTLE beacons, so that customers or employees notified if they are too close, managing software or human managing staff may use proximity data to manage restaurant more effectively, and other functionality may be provided that requires use of proximity-based data **2060**. Customer orders, requests, and other data input from the customer that is relevant to the business, may be sent from the client-side application to the BTLE beacon or beacons, which may be handled by the business point-of-sale and further sent to the server maintaining customer identification and usage data, to update the customer profile in the database, including recording any possible notes about the customer proximity if applicable **2070**, such as notes about the customer's route through the business or their proclivity for being near others or responding well to certain proximity-based dynamics in the business.

FIG. **21** is a method diagram illustrating a customer or patron walking past a business establishment, with a BTLE beacon or beacons and receivers communicating with the customer or patron device, such as one affixed to a door entryway or near a window facing a sidewalk. A customer first may walk near or walk past a business establishment **2110**, such as a restaurant, retail outlet, hotel, or other business, before a business-operated BTLE beacon pings customer mobile device with business info **2120**. Such a BTLE beacon may be a mounted or affixed device such as built into the ceiling, built into a wall or walls, affixed to a desk, affixed to a door or by a window to reach customers outside of the business, or it may be a mobile device with a BTLE transmitter and receiver and the associated application for driving the transmitter/receiver. The customer mobile device application may respond to the beacon ping with identifying info if the beacon is properly credentialed **2130**, from the customer's own BTLE transmitter/receiver. Proper business beacon credentials may be something stored locally on the customer mobile device, or it may be stored

on a server or cloud service that the application may communicate with over a network such as the Internet, and may be a defined set of credentials or a hash key that is defined by the application or application provider. The business BTLE beacon may forward any received customer info to a server or servers, or cloud service, to identify the customer, if they are a repeat-customer and known to the service **2140**. A brand-new customer who has never used the application before, or who has not used the application with this business before, may not be able to be identified, but as a new customer their identity within the application may be saved such as a hash of their username or other identifying information in compliance with local regulations and laws surrounding personal information, and their preferences and habits in the business may be saved as well throughout their interaction in the business. If they are identified, the business BTLE beacon or beacons may forward information such as incentives to enter the business, such as coupons, announcements of sales, special items the customer might be known to enjoy based on their prior data with the business, or other such data to attempt to gain the prospective customer, to the customer mobile device **2150**. A customer's entry, or failure to enter the business, and the rate of response for a sample of customers, may be sent by the BTLE beacon via their application to a local, internet, or cloud server to be recorded for data analytics **2160**, including which methods of communicating to the customer via beacon were successful and which were not.

FIG. **22** is a method diagram illustrating a customer or patron walking up to a desk-mounted device such as one mounted in the front of a hotel or other business front-end, to assist or even take the place of a maitre'd and communicate with a customer mobile device.

A customer first may walk into a business establishment **2210**, such as a restaurant, retail outlet, hotel, or other business, before a business-operated BTLE beacon pings customer mobile device with business info **2220**. Such a BTLE beacon may be a mounted or affixed device such as built into the ceiling, built into a wall or walls, affixed to a desk, or it may be a mobile device with a BTLE transmitter and receiver and the associated application for driving the transmitter/receiver. The customer mobile device application may respond to the beacon ping with identifying info if the beacon is properly credentialed **2230**, from the customer's own BTLE transmitter/receiver. Proper business beacon credentials may be something stored locally on the customer mobile device, or it may be stored on a server or cloud service that the application may communicate with over a network such as the Internet, and may be a defined set of credentials or a hash key that is defined by the application or application provider. A desk or table-affixed BTLE beacon, which may take the place of, or supplement and aid, a maitre'd such as at a hotel or a similar front-of-business manager for other types of establishments, may forward any received customer info to a local or remote server to identify the customer, if they are a repeat-customer and known to the service **2240**. They A brand-new customer who has never used the application before, or who has not used the application with this business before, may not be able to be identified, but as a new customer their identity within the application may be saved such as a hash of their username or other identifying information in compliance with local regulations and laws surrounding personal information, and their preferences and habits in the business may be saved as well throughout their interaction in the business. If they are identified, the business BTLE beacon or beacons may forward information such as menu data for no-contact ordering,

table assignment, reservation information for a hotel, or other business information that may be of interest to the customer, to the customer mobile device **2250**, while the customer proximity to other customers, to employees, and to certain parts of the business may be monitored with a plurality of business BTLE beacons, so that customers or employees notified if they are too close, managing software or human managing staff may use proximity data to manage restaurant more effectively, and other functionality may be provided that requires use of proximity-based data **2260**. Customer orders, requests, and other data input from the customer that is relevant to the business, may be sent from the client-side application to the BTLE beacon or beacons, which may be handled by the business point-of-sale and further sent to the server maintaining customer identification and usage data, to update the customer profile in the database, including recording any possible notes about the customer proximity if applicable **2270**, such as notes about the customer's route through the business or their proclivity for being near others or responding well to certain proximity-based dynamics in the business.

FIG. **23** is a method diagram illustrating steps in the functionality of a BTLE proximity application. A business-side application may be configured either from the application itself, or from a web portal or other application configuration tool, or from within the application itself with the configuration being copied over to other business devices. Such a business application may transmit periodic or continuous BTLE beacon signals via a BTLE transmitter **2310**, essentially polling for in-range customer applications to respond to the signal. A customer-side application, which may also be configured to the customer's liking on their mobile device, may listen for beacon signals via a BTLE receiver **2320**, while a mobile device is either being used or while it is idle such as in a pocket while the customer may be walking or sitting at a table. The customer-side application receives a business application's BTLE signal, and may verify that the signal comes from a recognized or legitimate business rather than i.e. from a hacker or glitch, and responds via transmitter **2330** to let the beacon know it has reached a customer. The validation process may take the form of checking the device's local storage for data on the business in question, or checking a server or cloud service for validation of the business, or the business may broadcast a hash that verifies it as legitimate with the client application even if the client application has never encountered the business before, such as with a piece of secure data that the application knows can only be generated by legitimate business BTLE beacon applications. The response may include basic customer identifying information if enabled and permitted by the user of the application, at which point the business-side application may receive the customer-side application's response, and attempt to verify the customer identity if possible **2340**, either with local storage of customer information or with a remote server that has access to a database of customer information, including identifying information. Such a database may be a SQL™ or NOSQL™ database format, such as MONGODB™, and identifying information could for instance take the form of a user's password hash and their username with the application, which may be checked against the database records securely. If the customer's identity is able to be verified, the business-side application may forward any business specified data to the customer's application over the BTLE signal connection, such as coupons, notices about special sales or pricings, new inventory, and other business messages that may be specified by the business itself **2350**. For proximity-based uses, the

customer's distance from the first beacon that successfully communicated with the customer calculated **2360**, based on the signal strength received from the customer, allowing for other beacons to further communicate with each other if the customer comes within range to triangulate the customer's location relative to the beacons with high accuracy **2370**. The beacons, whether affixed or being hosted on mobile devices such as smartphones in use by employees, may issue to the customer various proximity-based notices, such as table assignments if they're close enough to be considered "inside" a restaurant, or warnings to keep a certain distance to other customers or staff **2380**, or their proximity data may be used for analytics by the business.

FIG. **24** is a message flow diagram illustrating messages transferred between components in a system for zero-step customer proximity detection using mobile device low emissions beacons. At least two mobile devices exist, such as a smartphone, PDA, tablet, or other device, which may run an operating system including IOS™, WINDOWS MOBILE™, ANDROID™ and potentially others, and which may be in the possession of a customer or business client. The mobile devices are each connected to, or have built into them, individual BLUETOOTH™ Low Emissions ("BTLE") transmitters and receivers **1502**, **1506**, and an application that is configured to utilize such a transmitter/receiver **1503**, **1507**. Such an application may be written in a variety of programming languages, such as C, C++, C#, JAVA™, or others. The application may be written in a general-purpose manner to interact with any business BTLE beacon or mobile device acting as a beacon, such as a plurality of mobile devices operated by a business **1505**, and may either maintain a local memory store of recognized and known businesses (which may be treated differently than unknown business beacons) or may connect to a network and server **1520** to determine of a business' supplied information over BTLE transmitter and receiver communications is legitimate. Business mobile devices may represent a plurality of devices such as smartphones, PDAs, tablets, or other devices, which do not necessarily need to all of one device type, which may run operating systems including IOS™, WINDOWS MOBILE™ ANDROID™, and potentially others, each of which possesses a BTLE transmitter and receiver **1506** and a business-side application configured to utilize the BTLE transmitter/receiver **1507**.

As a possible first step in the flow of messages between these components, a business-side BTLE application **1507** forwards a data ping to its own transmitter/receiver **1506**, to a customer's receiver **1502**, which is then interpreted by the customer's application **1503**, **2410**. Such a data ping could simply be encoded or encrypted business-identifying information, which only a customer application **1503** could unencode or decrypt and properly validate, but which would be useless to interceptors. A customer application **1503** makes a response message, which is sent to its own transmitter **1502**, to the beacon's receiver **1506**, and interpreted by the beacon's application **1507**, with the customer's information **2420**, which may be identifying information such as a username and password hash, just a username, the customer's real name, or some other singular or combination of identifying information, and may include preference information relevant to the business if specified by the user. The business application **1507** may make a customer verification or identification call **2430** across a local area or wide area network to a server **1520** that may be able to determine in a connected database whether the customer is who they claim to be, and if there is any relevant data on the customer such as known preferences or habits that the business

applications should be aware of, such as which coupons to entice a customer with. Any information on the customer that the server **1520** is able to verify and access is sent to the business application **1507**, **2440**. The business application **1507** then transmits to the customer application **1503** any business-specific data that the business application may determine is relevant to the customer **2450**. For example, the business application may be told by the server **1520** that the customer has been to the business, such as a café, before, and ordered a slice of cheesecake. The business application may then offer the customer 10% off a slice of cheesecake as an informal loyalty reward, or may simply mention that they have a new variety or flavor of cheesecake available to order now, to entice the customer or provide better automated customer service. A customer application **1503** may then respond to a previous data transmission by the business application **1507**, or send its own transmission regardless of a previous transmission from a business application **1507**, such as a menu choice for no-contact menu ordering, setting reservations at a hotel, or responding to coupons offered by the business application **2460**. A variety of proximity-based alerts and data transmissions may be possible from the business application **1507** to the client application **1503**, **2470**, such as telling them which table is theirs, letting them see where the nearest staff member is on a map of the business floor, warning them of their proximity to perhaps other customers or a fire exit, and more.

Many possible uses for proximity data and proximity-time-series data exist for businesses, and it will be apparent to many with average skill in the art that this system may be used for several other purposes using the same configuration and methods as described herein, for analytics, customer service, and more.

FIG. **26** is a flow diagram of an exemplary method for providing zero-step proximity detection and private matchmaking, according to an aspect of an embodiment. The process begins at step **2601** when a first user with a mobile device **2505** and second user with a mobile device **2505** enter into the operating radius of a BTLE beacon. The BTLE beacon may be a beacon deployed at a business establishment, or it may be a mobile device **2505** operating as a BTLE beacon. As a next step **2602**, the BTLE beacon device(s) ping the first user's mobile device and the second user's mobile device. The first user mobile device application can respond to the beacon ping with identifying information if the beacon is properly credentialed **2603**. The response may comprise any one of or a combination of: a first device identifier for the first user's mobile device, a first signal strength of the beacon signal as received by the first user's mobile device, and a second signal strength of a wireless connection with a second mobile device as received by the first user's mobile device. As a next step **2604**, the second user mobile device application can respond to the beacon ping with identifying information if the beacon is properly credentialed, wherein the response may comprise any one of or a combination of: a second device identifier for the second user's mobile device, a third signal strength of the beacon signal as received by the second user's mobile device, and a fourth signal strength of a wireless connection with the first user's mobile device as received by the second user's mobile device. As a next step **2605**, each of the first and second users' identifying information can be sent to a server **2520** to verify the users' identity and to retrieve user information from a database **2530**. According to some embodiments, the user information may comprise a photograph of the user. Using the response information, the proximity of first user to the second user is computed at step

2606. The proximity may be calculated by triangulation to determine relative distances between the BTLE beacon, the first user's mobile device, and the second user's mobile device using the first, second, third, and fourth signal strengths. After the proximity has been calculated, notifications may be generated and sent to both the first and second users' mobile devices, wherein the notification comprises an indication that each user is in close proximity to another user and a request to exchange photographs between the two users **2607**. The first and second user may either approve or reject the request to exchange photographs. Upon approval of the request to exchange photographs from the first user and second user **2608**, the system may send another notification to the first user, the notification may comprise proximity/location information about the second user and a photograph of the second user **2609**. As a last step **2610**, another notification may be sent to the second user, the notification may comprise proximity/location information about the first user and a photograph of the first user. In this way, the system may provide a method for zero-step proximity detection and private matchmaking to system users. Hardware Architecture

Generally, the techniques disclosed herein may be implemented on hardware or a combination of software and hardware. For example, they may be implemented in an operating system kernel, in a separate user process, in a library package bound into network applications, on a specially constructed machine, on an application-specific integrated circuit (ASIC), or on a network interface card.

Software/hardware hybrid implementations of at least some of the aspects disclosed herein may be implemented on a programmable network-resident machine (which should be understood to include intermittently connected network-aware machines) selectively activated or reconfigured by a computer program stored in memory. Such network devices may have multiple network interfaces that may be configured or designed to utilize different types of network communication protocols. A general architecture for some of these machines may be described herein in order to illustrate one or more exemplary means by which a given unit of functionality may be implemented. According to specific aspects, at least some of the features or functionalities of the various aspects disclosed herein may be implemented on one or more general-purpose computers associated with one or more networks, such as for example an end-user computer system, a client computer, a network server or other server system, a mobile computing device (e.g., tablet computing device, mobile phone, smartphone, laptop, or other appropriate computing device), a consumer electronic device, a music player, or any other suitable electronic device, router, switch, or other suitable device, or any combination thereof. In at least some aspects, at least some of the features or functionalities of the various aspects disclosed herein may be implemented in one or more virtualized computing environments (e.g., network computing clouds, virtual machines hosted on one or more physical computing machines, or other appropriate virtual environments).

Referring now to FIG. **11**, there is shown a block diagram depicting an exemplary computing device **10** suitable for implementing at least a portion of the features or functionalities disclosed herein. Computing device **10** may be, for example, any one of the computing machines listed in the previous paragraph, or indeed any other electronic device capable of executing software- or hardware-based instructions according to one or more programs stored in memory. Computing device **10** may be configured to communicate with a plurality of other computing devices, such as clients

or servers, over communications networks such as a wide area network, a metropolitan area network, a local area network, a wireless network, the Internet, or any other network, using known protocols for such communication, whether wireless or wired.

In one aspect, computing device **10** includes one or more central processing units (CPU) **12**, one or more interfaces **15**, and one or more busses **14** (such as a peripheral component interconnect (PCI) bus). When acting under the control of appropriate software or firmware, CPU **12** may be responsible for implementing specific functions associated with the functions of a specifically configured computing device or machine. For example, in at least one aspect, a computing device **10** may be configured or designed to function as a server system utilizing CPU **12**, local memory **11** and/or remote memory **16**, and interface(s) **15**. In at least one aspect, CPU **12** may be caused to perform one or more of the different types of functions and/or operations under the control of software modules or components, which for example, may include an operating system and any appropriate applications software, drivers, and the like.

CPU **12** may include one or more processors **13** such as, for example, a processor from one of the Intel, ARM, Qualcomm, and AMD families of microprocessors. In some aspects, processors **13** may include specially designed hardware such as application-specific integrated circuits (ASICs), electrically erasable programmable read-only memories (EEPROMs), field-programmable gate arrays (FPGAs), and so forth, for controlling operations of computing device **10**. In a particular aspect, a local memory **11** (such as non-volatile random access memory (RAM) and/or read-only memory (ROM), including for example one or more levels of cached memory) may also form part of CPU **12**. However, there are many different ways in which memory may be coupled to system **10**. Memory **11** may be used for a variety of purposes such as, for example, caching and/or storing data, programming instructions, and the like. It should be further appreciated that CPU **12** may be one of a variety of system-on-a-chip (SOC) type hardware that may include additional hardware such as memory or graphics processing chips, such as a QUALCOMM SNAP-DRAGON™ or SAMSUNG EXYNOS™ CPU as are becoming increasingly common in the art, such as for use in mobile devices or integrated devices.

As used herein, the term “processor” is not limited merely to those integrated circuits referred to in the art as a processor, a mobile processor, or a microprocessor, but broadly refers to a microcontroller, a microcomputer, a programmable logic controller, an application-specific integrated circuit, and any other programmable circuit.

In one aspect, interfaces **15** are provided as network interface cards (NICs). Generally, NICs control the sending and receiving of data packets over a computer network; other types of interfaces **15** may for example support other peripherals used with computing device **10**. Among the interfaces that may be provided are Ethernet interfaces, frame relay interfaces, cable interfaces, DSL interfaces, token ring interfaces, graphics interfaces, and the like. In addition, various types of interfaces may be provided such as, for example, universal serial bus (USB), Serial, Ethernet, FIREWIRE™, THUNDERBOLT™, PCI, parallel, radio frequency (RF), BLUETOOTH™, near-field communications (e.g., using near-field magnetics), 802.11 (WiFi), frame relay, TCP/IP, ISDN, fast Ethernet interfaces, Gigabit Ethernet interfaces, Serial ATA (SATA) or external SATA (ESATA) interfaces, high-definition multimedia interface (HDMI), digital visual interface (DVI), analog or digital

audio interfaces, asynchronous transfer mode (ATM) interfaces, high-speed serial interface (HSSI) interfaces, Point of Sale (POS) interfaces, fiber data distributed interfaces (FD-DIs), and the like. Generally, such interfaces **15** may include physical ports appropriate for communication with appropriate media. In some cases, they may also include an independent processor (such as a dedicated audio or video processor, as is common in the art for high-fidelity A/V hardware interfaces) and, in some instances, volatile and/or non-volatile memory (e.g., RAM).

Although the system shown in FIG. **11** illustrates one specific architecture for a computing device **10** for implementing one or more of the aspects described herein, it is by no means the only device architecture on which at least a portion of the features and techniques described herein may be implemented. For example, architectures having one or any number of processors **13** may be used, and such processors **13** may be present in a single device or distributed among any number of devices. In one aspect, a single processor **13** handles communications as well as routing computations, while in other aspects a separate dedicated communications processor may be provided. In various aspects, different types of features or functionalities may be implemented in a system according to the aspect that includes a client device (such as a tablet device or smartphone running client software) and server systems (such as a server system described in more detail below).

Regardless of network device configuration, the system of an aspect may employ one or more memories or memory modules (such as, for example, remote memory block **16** and local memory **11**) configured to store data, program instructions for the general-purpose network operations, or other information relating to the functionality of the aspects described herein (or any combinations of the above). Program instructions may control execution of or comprise an operating system and/or one or more applications, for example. Memory **16** or memories **11**, **16** may also be configured to store data structures, configuration data, encryption data, historical system operations information, or any other specific or generic non-program information described herein.

Because such information and program instructions may be employed to implement one or more systems or methods described herein, at least some network device aspects may include nontransitory machine-readable storage media, which, for example, may be configured or designed to store program instructions, state information, and the like for performing various operations described herein. Examples of such nontransitory machine-readable storage media include, but are not limited to, magnetic media such as hard disks, floppy disks, and magnetic tape; optical media such as CD-ROM disks; magneto-optical media such as optical disks, and hardware devices that are specially configured to store and perform program instructions, such as read-only memory devices (ROM), flash memory (as is common in mobile devices and integrated systems), solid state drives (SSD) and “hybrid SSD” storage drives that may combine physical components of solid state and hard disk drives in a single hardware device (as are becoming increasingly common in the art with regard to personal computers), memristor memory, random access memory (RAM), and the like. It should be appreciated that such storage means may be integral and non-removable (such as RAM hardware modules that may be soldered onto a motherboard or otherwise integrated into an electronic device), or they may be removable such as swappable flash memory modules (such as “thumb drives” or other removable media designed for

rapidly exchanging physical storage devices), “hot-swappable” hard disk drives or solid state drives, removable optical storage discs, or other such removable media, and that such integral and removable storage media may be utilized interchangeably. Examples of program instructions include both object code, such as may be produced by a compiler, machine code, such as may be produced by an assembler or a linker, byte code, such as may be generated by for example a JAVA™ compiler and may be executed using a Java virtual machine or equivalent, or files containing higher level code that may be executed by the computer using an interpreter (for example, scripts written in Python, Perl, Ruby, Groovy, or any other scripting language).

In some aspects, systems may be implemented on a standalone computing system. Referring now to FIG. 12, there is shown a block diagram depicting a typical exemplary architecture of one or more aspects or components thereof on a standalone computing system. Computing device 20 includes processors 21 that may run software that carry out one or more functions or applications of aspects, such as for example a client application 24. Processors 21 may carry out computing instructions under control of an operating system 22 such as, for example, a version of MICROSOFT WINDOWS™ operating system, APPLE macOS™ or iOS™ operating systems, some variety of the Linux operating system, ANDROID™ operating system, or the like. In many cases, one or more shared services 23 may be operable in system 20, and may be useful for providing common services to client applications 24. Services 23 may for example be WINDOWS™ services, user-space common services in a Linux environment, or any other type of common service architecture used with operating system 21. Input devices 28 may be of any type suitable for receiving user input, including for example a keyboard, touchscreen, microphone (for example, for voice input), mouse, touchpad, trackball, or any combination thereof. Output devices 27 may be of any type suitable for providing output to one or more users, whether remote or local to system 20, and may include for example one or more screens for visual output, speakers, printers, or any combination thereof. Memory 25 may be random-access memory having any structure and architecture known in the art, for use by processors 21, for example to run software. Storage devices 26 may be any magnetic, optical, mechanical, memristor, or electrical storage device for storage of data in digital form (such as those described above, referring to FIG. 11). Examples of storage devices 26 include flash memory, magnetic hard drive, CD-ROM, and/or the like.

In some aspects, systems may be implemented on a distributed computing network, such as one having any number of clients and/or servers. Referring now to FIG. 13, there is shown a block diagram depicting an exemplary architecture 30 for implementing at least a portion of a system according to one aspect on a distributed computing network. According to the aspect, any number of clients 33 may be provided. Each client 33 may run software for implementing client-side portions of a system; clients may comprise a system 20 such as that illustrated in FIG. 12. In addition, any number of servers 32 may be provided for handling requests received from one or more clients 33. Clients 33 and servers 32 may communicate with one another via one or more electronic networks 31, which may be in various aspects any of the Internet, a wide area network, a mobile telephony network (such as CDMA or GSM cellular networks), a wireless network (such as WiFi, WiMAX, LTE, and so forth), or a local area network (or indeed any network topology known in the art; the aspect

does not prefer any one network topology over any other). Networks 31 may be implemented using any known network protocols, including for example wired and/or wireless protocols.

In addition, in some aspects, servers 32 may call external services 37 when needed to obtain additional information, or to refer to additional data concerning a particular call. Communications with external services 37 may take place, for example, via one or more networks 31. In various aspects, external services 37 may comprise web-enabled services or functionality related to or installed on the hardware device itself. For example, in one aspect where client applications 24 are implemented on a smartphone or other electronic device, client applications 24 may obtain information stored in a server system 32 in the cloud or on an external service 37 deployed on one or more of a particular enterprise’s or user’s premises. In addition to local storage on servers 32, remote storage 38 may be accessible through the network(s) 31.

In some aspects, clients 33 or servers 32 (or both) may make use of one or more specialized services or appliances that may be deployed locally or remotely across one or more networks 31. For example, one or more databases 34 in either local or remote storage 38 may be used or referred to by one or more aspects. It should be understood by one having ordinary skill in the art that databases in storage 34 may be arranged in a wide variety of architectures and using a wide variety of data access and manipulation means. For example, in various aspects one or more databases in storage 34 may comprise a relational database system using a structured query language (SQL), while others may comprise an alternative data storage technology such as those referred to in the art as “NoSQL” (for example, HADOOP CASSANDRA™, GOOGLE BIGTABLE™, and so forth). In some aspects, variant database architectures such as column-oriented databases, in-memory databases, clustered databases, distributed databases, or even flat file data repositories may be used according to the aspect. It will be appreciated by one having ordinary skill in the art that any combination of known or future database technologies may be used as appropriate, unless a specific database technology or a specific arrangement of components is specified for a particular aspect described herein. Moreover, it should be appreciated that the term “database” as used herein may refer to a physical database machine, a cluster of machines acting as a single database system, or a logical database within an overall database management system. Unless a specific meaning is specified for a given use of the term “database”, it should be construed to mean any of these senses of the word, all of which are understood as a plain meaning of the term “database” by those having ordinary skill in the art.

Similarly, some aspects may make use of one or more security systems 36 and configuration systems 35. Security and configuration management are common information technology (IT) and web functions, and some amount of each are generally associated with any IT or web systems. It should be understood by one having ordinary skill in the art that any configuration or security subsystems known in the art now or in the future may be used in conjunction with aspects without limitation, unless a specific security 36 or configuration system 35 or approach is specifically required by the description of any specific aspect.

FIG. 14 shows an exemplary overview of a computer system 40 as may be used in any of the various locations throughout the system. It is exemplary of any computer that may execute code to process data. Various modifications and

changes may be made to computer system 40 without departing from the broader scope of the system and method disclosed herein. Central processor unit (CPU) 41 is connected to bus 42, to which bus is also connected memory 43, nonvolatile memory 44, display 47, input/output (I/O) unit 48, and network interface card (NIC) 53. I/O unit 48 may, typically, be connected to peripherals such as a keyboard 49, pointing device 50, hard disk 52, real-time clock 51, a camera 57, and other peripheral devices. NIC 53 connects to network 54, which may be the Internet or a local network, which local network may or may not have connections to the Internet. The system may be connected to other computing devices through the network via a router 55, wireless local area network 56, or any other network connection. Also shown as part of system 40 is power supply unit 45 connected, in this example, to a main alternating current (AC) supply 46. Not shown are batteries that could be present, and many other devices and modifications that are well known but are not applicable to the specific novel functions of the current system and method disclosed herein. It should be appreciated that some or all components illustrated may be combined, such as in various integrated applications, for example Qualcomm or Samsung system-on-a-chip (SOC) devices, or whenever it may be appropriate to combine multiple capabilities or functions into a single hardware device (for instance, in mobile devices such as smartphones, video game consoles, in-vehicle computer systems such as navigation or multimedia systems in automobiles, or other integrated hardware devices).

In various aspects, functionality for implementing systems or methods of various aspects may be distributed among any number of client and/or server components. For example, various software modules may be implemented for performing various functions in connection with the system of any particular aspect, and such modules may be variously implemented to run on server and/or client components.

The skilled person will be aware of a range of possible modifications of the various aspects described above. Accordingly, the present invention is defined by the claims and their equivalents.

What is claimed is:

1. A system for zero-step proximity detection and private matchmaking using mobile device low emissions beacons, comprising:

a wireless network beacon installed at a business location comprising a first memory, a first processor, and a first plurality of programming instructions stored in the first memory, and operating on the first processor, wherein the first plurality of programming instructions, when operating on the first processor, causes the wireless network beacon to:

emit a beacon signal with short-range wireless communications;

wherein the beacon signal comprises identifying information and application information associated with wireless network beacon, and a query for signal strength information;

receive a first response from a first mobile device reached by the emitted beacon signal, the first response comprising a first device identifier for the first mobile device, a first signal strength of the beacon signal as received by the first mobile device, and a second signal strength of a wireless connection with a second mobile device as received by the first mobile device;

receive a second response from the second mobile device reached by the emitted beacon signal, the

second response comprising a second device identifier for the second mobile device, a third signal strength of the beacon signal as received by the second mobile device, and a fourth signal strength of a wireless connection with the first mobile device as received by the second mobile device;

calculate by triangulation relative distances between the wireless network beacon, the first mobile device, and the second mobile device using the first, second, third, and fourth signal strengths;

send the first device identifier and second device identifier to a remote computer server;

receive from the remote computer server a first photograph associated with the first mobile device and a second photograph associated with the second mobile device;

send a first notification to the first mobile device, the first notification comprising an indication that the first mobile device is in proximity to the second mobile device and a first request to send the first photograph to the second mobile device;

send a second notification to the second mobile device, the notification comprising an indication that the second mobile device is in proximity to the first mobile device and a second request to send the second photograph to the first mobile device;

upon approval of the first request send a third notification to the first mobile device of the relative distance from the first mobile device to the second mobile device along with the second photograph; and

upon approval of the second request send a fourth notification to the second mobile device of the relative distance from the second mobile device to the first mobile device along with the first photograph.

2. The system of claim 1, wherein the computer server is a remote business server comprising a second memory, a second processor, the database comprising customer information, and a second plurality of programming instructions stored in the second memory, and operating on the second processor, wherein the second plurality of programming instructions, when operating on the second processor, causes the remote business server to:

receive the first device identifier and second device identifier;

retrieve the first photograph associated with the person associated with the first mobile device from a database comprising customer information;

retrieve the second photograph associated with the person associated with the second mobile device from the database comprising customer information; and

send the first photograph and second photograph to the wireless network beacon.

3. The system of claim 2, further comprising a database stored on the remote business server comprising customer information, the customer information comprising:

a list of registered wireless mobile devices;

a device identifier for each registered wireless mobile device; and

a photograph of a customer associated with each registered wireless mobile device.

4. The system of claim 1, wherein the first photograph, the second photograph, and the relative distances between the first mobile device and second mobile device are sent to a third mobile device operated by an employee of the business location.

5. The system of claim 1, wherein the wireless network beacon is part of a third mobile device operated by an employee of the business location.

6. The system of claim 1, wherein the wireless network beacon is part of a desk-affixed device for servicing customers at the business location.

7. The system of claim 1, wherein the wireless network beacon is a device affixed to a part of a building, wherein the wireless network beacon is configured to reach customers that may walk by a business establishment.

8. The system of claim 3, wherein the remote business server further comprises a point-of-sale system, and wherein the database comprising customer information further includes information on past customer interactions and customer preferences, and wherein the wireless network beacon further communicates with the database comprising customer information to determine preferences or past sales information of the person associated with the first mobile device or the person associated with the second mobile device.

9. A method for zero-step proximity detection and private matchmaking using mobile device low emissions beacons, comprising the steps of:

emitting a beacon signal with short-range wireless communications;

wherein the beacon signal comprises identifying information and application information associated with wireless network beacon, and a query for signal strength information;

receiving a first response from a first mobile device reached by the emitted beacon signal, the first response comprising a first device identifier for the first mobile device, a first signal strength of the beacon signal as received by the first mobile device, and a second signal strength of a wireless connection with a second mobile device as received by the first mobile device;

receiving a second response from the second mobile device reached by the emitted beacon signal, the second response comprising a second device identifier for the second mobile device, a third signal strength of the beacon signal as received by the second mobile device, and a fourth signal strength of a wireless connection with the first mobile device as received by the second mobile device;

calculating by triangulation relative distances between the wireless network beacon, the first mobile device, and the second mobile device using the first, second, third, and fourth signal strengths;

sending the first device identifier and second device identifier to a remote computer server;

receiving from the remote computer server a first photograph associated with the first mobile device and a second photograph associated with the second mobile device;

sending a first notification to the first mobile device, the first notification comprising an indication that the first mobile device is in proximity to the second mobile device and a first request to send the first photograph to the second mobile device;

sending a second notification to the second mobile device, the notification comprising an indication that the second mobile device is in proximity to the first mobile

device and a second request to send the second photograph to the first mobile device;

upon approval of the first request sending a third notification to the first mobile device of the relative distance from the first mobile device to the second mobile device along with the second photograph; and

upon approval of the second request sending a fourth notification to the second mobile device of the relative distance from the second mobile device to the first mobile device along with the first photograph.

10. The method of claim 9, wherein the computer server is a remote business server comprising a second memory, a second processor, the database comprising customer information, and a second plurality of programming instructions stored in the second memory, and operating on the second processor, wherein the second plurality of programming instructions, when operating on the second processor, causes the remote business server to perform the steps of:

receiving the first device identifier and second device identifier;

retrieving the first photograph associated with the person associated with the first mobile device from a database comprising customer information;

retrieving the second photograph associated with the person associated with the second mobile device from the database comprising customer information; and sending the first photograph and second photograph to the wireless network beacon.

11. The method of claim 10, further comprising a database stored on the remote business server comprising customer information, the customer information comprising:

a list of registered wireless mobile devices;

a device identifier for each registered wireless mobile device; and

a photograph of a customer associated with each registered wireless mobile device.

12. The method of claim 9, wherein the first photograph, the second photograph, and the relative distances between the first mobile device and second mobile device are sent to a third mobile device operated by an employee of the business location.

13. The method of claim 9, wherein the wireless network beacon is part of a third mobile device operated by an employee of the business location.

14. The method of claim 9, wherein the wireless network beacon is part of a desk-affixed device for servicing customers at the business location.

15. The method of claim 9, wherein the wireless network beacon is a device affixed to a part of a building, wherein the wireless network beacon is configured to reach customers that may walk by a business establishment.

16. The method of claim 10, wherein the remote business server further comprises a point-of-sale system, and wherein the database comprising customer information further includes information on past customer interactions and customer preferences, and wherein the wireless network beacon further communicates with the database comprising customer information to determine preferences or past sales information of the person associated with the first mobile device or the person associated with the second mobile device.